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THE
EMPIRE COTTON GROWING
REVIEW

VOL. II. JANUARY, 1925. NO. 1.

RAIN COTTON DEVELOPMENT IN THE SUDAN

BY

A. J. C. HUDDLESTON, O.B.E.
Governor of Blue Nile Province, Sudan.

THE present time seems opportune to review generally the position as regards the development of rain and flood American cotton in the Sudan, with particular reference to the Blue Nile and surrounding Provinces.

Recent facts in the Blue Nile Province may be summarized as follows, the figures given being in kantars of 315 lbs. seed cotton (about 5 to the bale of ginned cotton, 500 lbs.):

Season.	*Bags of Seed issued by Government.*	*Amount known to have been Exported (Kantars).*	*Estimated Total Crop (Kantars).*	*Value of Crop in Egyptian £.*
1921-22	Nil	150	200	600
1922-23	70	1,700	2,000	7,000
1923-24	550	5,000	5,500	30,000
1924-25	3,300	—	—	—

The value quoted is the value at Wad Medani. It should be noted that the 1922 rains were much better than those of 1923.

The figures are somewhat approximate, and on merchants' returns I should be justified in putting the 1923-24 figures higher, but as considerable quantities of mixed American and native cotton left the province, I have not thought it safe to take a higher figure for the American.

As regards native cotton, I have no figures available for the 1921-22 and the 1922-23 seasons, but the export was certainly very small—in the 1923-24 season the Blue Nile Province production was certainly not less than 4,000 kantars, of which it is estimated that 3,150 were exported from the Sudan.

This export trade in native cotton has sprung up in consequence of the trade in American cotton, and steps have now been taken to prohibit it, as there have been signs of attempts being made to pass off a mixture of American and native cotton as American.

The surrounding provinces have also been sending cotton into the Blue Nile, the total exports from that province during the 1923-24 season being 11,700 kantars of 315 lbs., giving 2,320 bales, which are believed to represent approximately:

	Kantars.
Blue Nile Province, American	5,000
Blue Nile Province, Native	3,150
Kassala Province, probably half American, half native	1,200
Fung Province	1,850
White Nile Province, entirely native	500
Total	11,700

The Fung cotton is mostly bastard American, being derived from old seed issues dating back some ten years, which in the course of time have been crossed and blended with native strains to such an extent that the product is hopelessly hybrid. The Fung total included, however, small quantities of pure American, grown from recent seed issues, and of ordinary native cotton.

The above are the facts as known at present, and though extremely satisfactory from a local point of view, it is obvious that a production of 1,000 bales of American cotton in one province is of no great general interest unless it is likely to lead to bigger results.

If this production can be largely increased and extended into other parts of the Sudan, the methods by which these results have been obtained may be of general interest.

In the Blue Nile Province the rainfall is the limiting factor—the average rainfall at Wad Medani is 14 inches, and cotton requires at least 20 inches. It can, therefore, only be grown in natural depressions known as "uguds," into which water naturally drains, or in small quantities near banks (terrasses) constructed in places where there is some slight slope, so as to concentrate the water falling on the whole of a plot of land on to one particular portion of it. There are also certain possibilities of growing American cotton on land flooded by the river. The areas of all such classes of land are definitely limited, the great bulk of the province requiring irrigation to grow cotton. Once the seed issues reach 5,000 bags, I consider that the rate of increase will slow down very appreciably.

In the Fung and Kassala Provinces there is a much greater rainfall, which carries with it greater difficulties in dealing with weeds, and in Kassala there is a shortage of population. I have not had the same opportunities of studying White Nile conditions, but I believe they are similar to those in the Blue Nile, except that there are greater possibilities of flood cultivation on the river.

It is difficult to forecast ultimate possibilities, but I am convinced that if rain cotton cultivation is pushed as a consistent policy in all four provinces, the seed distribution will reach 10,000 bags within three years, which should enable 200,000 acres to be sown with American cotton. This should give a yield of not less than ½ kantar an acre, while in years of good rainfall 1 kantar may be reached. I look forward, therefore, to a production in the immediate future in these provinces of anything from 100,000 to 200,000 kantars, giving 20,000 to 40,000 bales. There are good prospects of still further expansion in these four provinces apart from probable development in other provinces.

It is worth while referring here to the effect of this increased cotton production on the food resources of the Sudan. I recently studied carefully the effect of the 1923-24 cotton production in the Blue Nile on the food position. The Blue Nile Province is the largest producer of dura of all the Sudan provinces. Dura is the staple food of the people, and in some years there is a considerable export trade in it, but if the rains are bad, local prices rise to a height that makes export impossible, unless there are large reserves in the country from previous years. In 1923 the rains were only moderate, and the crop was well below average, but large reserves were known to exist. The exact amount was, however, unknown, and there was some doubt as to whether any large export of dura from the country was desirable, in view of the possibility of bad rains in 1924. Actually, local prices kept at a level which made any large export impossible, and this was undoubtedly partly due to the extension of cotton-growing in the province. In fact, Blue Nile cultivators received approximately £E40,000 for their cotton. Of this it is estimated that £E10,000 was spent on luxuries that would not have been purchased but for the cotton, and £E30,000 was used for the purchase of necessities and the payment of taxes, the money for which would otherwise have been obtained by the sale of dura. This would have brought some 7,000 tons of additional dura into the markets, and would have forced dura prices down considerably. The actual exports from the province during the cotton season, including export to other provinces, amounted to 15,000 tons approximately. With lower prices and an extra 7,000 tons on the market, it is probable that an additional 2,000 tons would have had to be sold to enable cultivators to find their cash requirements. Some 9,000 tons, therefore, probably remain in the hands of the cultivators, which, but for cotton, would have come into the market and, with lower prices, would certainly have been exported from the country. Against this must be put 3,000 tons, which is the maximum production of the land under cotton had it been sown with dura, and we are left with a figure of 6,000 tons as the net additional food reserves left in the country owing to the 1923-24 cotton crop.

As the cotton crop increases, the amount of money spent on luxuries will, of course, increase, and the greater spending capacity of the people will benefit trade generally and importers in particular. The export of dura will fall off, but there is so much land in the Blue Nile suitable for dura, and not for rain cotton, that I do not consider this cotton development will endanger the local food position in the Sudan. It will, on the contrary, tend to stabilize it, as more dura will be stored in years of good rains and more stored dura will be available in years of bad rains.

The methods of development which have been followed in the Blue Nile Province may be described as education, seed distribution, and provision of market facilities.

From the latter point of view we have been in a very favourable position, as the Sudan Plantations Syndicate have always been ready to pay a fair price at Wad Medani, and there has, in consequence, been no risk of prices being forced down unduly. The province staff, with the assistance of an agricultural inspector, is always ready to take over American cotton at any local centre and arrange its transport to Medani, where it is sold on behalf of the cultivator to the Sudan Plantations Syndicate or any buyer offering a better price. But in practice this has very seldom been necessary, as the announcement of prices that we can obtain for the cultivator by this method has always caused merchants in other places to raise their price to something near enough to the Wad Medani price. This question of market arrangements is mixed up with classification, and will be referred to again later.

Seed distribution and propaganda go hand in hand. The essentials are that every possible step should be taken to bring home to the people the advantages of growing cotton with selected American seed, that adequate quantities of seed should be available to meet all demands, and that payment for the seed should be deferred until the crop is picked. Actually, in 1925 no direct charge will be made to the cultivator for seed, but a small levy will be made in the markets on every kantar sold, to cover our expenditure on seed.

It must be remembered that native cotton has always been grown in the Blue Nile Province. In Dervish times an annual tribute was levied on the Gezira (the district between the Blue and White Niles, now partly in the Blue Nile and partly in the White Nile Provinces), which eventually reached 100,000 rolls of cotton cloth a year in addition to other things. I understand that, as the number of rolls demanded increased, so did the size of the rolls supplied decrease, so that the tribute was not quite so formidable as it sounds. Native cotton, however, has hardly ever commanded any market outside the Sudan, and with the local demand easily met it has been of no value as a means by which the native could obtain cash. In the Blue Nile there has been practically no cash rain crop produced except dura, and the whole tradition of the people being to keep large food reserves against years of bad rains, this lack of another cash crop has, in fact, been the weakest point in the economic position of the native of the province.

When propaganda for American cotton was started great stress was laid on this point. Very little was said as to methods of cultivation, as, in fact, very little was known except that wherever it had been tried the American had, with anything like decent conditions, done as well as or better than the native cotton. The people were simply encouraged to sow American in the same way that they had sown native cotton in the past. Special stress was laid on the advantage of having a cash crop other than dura, for which there was a large market, and the price of which, unlike dura, would not be forced down by large local production. After the first season every opportunity was taken to advertise the results obtained by successful cultivators. Among these there was, most fortunately, a well-known man connected with a big religious family who had sown 80 acres and obtained a yield of nearly a kantar an acre, so that he received £E240 for his cotton at a time when the cultivator who got more than £E1 per acre for his dura was quite pleased. Needless to say, this man's success was quoted by us at every possible opportunity. Full advantage was also taken of the natural wish of the native to stand well with those in authority over him, and undoubtedly many sowed the first year to please the authorities, but having done well sowed an increased area in the second year in a more serious spirit.

In a very short time the people came to expect an address on American cotton at all visits one paid to their villages, and I remember one occasion when I began by talking about smut in dura, which was troubling dura exporters last year, and at every opportunity I was interrupted with questions about American cotton, showing what it was expected that I should talk about.

Just two years' steady propaganda have produced the results shown above. The demands for seed have always been just ahead of the arrangements made for its supply, but the seed available has always been near enough to the demand, and any shortage there has been has possibly helped to make the people keener.

The essence of the whole affair is co-operation between the administrative and the technical authorities. Up to date, the bulk of the work in the Blue Nile has been done by the administrative staff of the province, and it is obvious that they are in a position to do far more effective propaganda than any technical official. Propaganda is not a technical matter, and to leave it to technical officials not only involves duplication of staff, but it reduces the use that can be made of the natural wish of the native to please the officials who have most direct authority over him.

At the same time, there is a limit to the amount of agricultural work that can be done by administrative officials, however strong their individual bent for agricultural development may be. Study of crop conditions, study of pests, investigation as to the best type of seed, and the handling of any cotton which may pass through Government's hands before it is sold, are essentially matters which must be dealt with by the technical staff. The decision of the Sudan Government to appoint two agricultural inspectors for rain cotton work in the provinces of the Blue Nile, Fung, and Kassala is therefore a most important step. In this connection it is worth recording that last May a special committee was appointed to co-ordinate the growing of rain cotton in these three provinces, consisting of the Governors of the three provinces and the Director of Agriculture. It is possible that it will be found advisable to include the White Nile Province in the sphere covered by this committee.

One of the main problems that has to be dealt with in connection with this development is how to ensure that the quality of the cotton exported is as uniform as possible. Up to date it has not been possible to do much in this direction, as all energies have been concentrated on working up the quantity of cotton produced, but from next season this matter will be properly taken in hand.

The great difficulty in this connection is the question of the native variety of cotton. This is used largely by native women for spinning cotton locally, an industry which it is not desirable to discourage, but which is one that needs control in connection with the pink boll worm problem which will be mentioned later on.

The general policy followed in the Blue Nile Province has been to encourage the growing of American cotton everywhere, but not to forbid the growing of the native variety, except in districts where the growing of American has taken hold thoroughly, and the great majority of cultivators appreciate the desirability of prohibiting inferior varieties. There is power under the Cotton Ordinance promulgated in 1912 for regulations to be made proclaiming certain districts in which only approved seed may be sown. Certain districts of the Blue Nile were proclaimed this year, and it is probable that the rest of the province, except perhaps Kamlin district, where the rainfall is lighter, will be proclaimed next year. It is also probable that certain districts of the Kassala and Fung Provinces will be proclaimed before the 1925 rains. It is obvious that so long as the growing of native cotton is allowed there is a certain risk of mixing, but steps have already been taken to reduce this risk to a minimum. As from the beginning of next season the export of native cotton has been forbidden, and regulations have also been passed by the Governor-General in Council by which all cotton exported from the Blue Nile Province, whether grown in that province or in neighbouring provinces, must pass through certain recognised markets, where an official classifier will be provided, and the cotton will be properly graded. Steps will be taken to ensure that, after ginning, the bales shall be marked in accordance with the original classification in the markets, and that native cotton will only be accepted by the railways for destinations where it will be used locally and not exported. It is hoped, therefore, that the quality of next year's crop will be more uniform than that of the past season.

The most serious pests attacking rain cotton in the Blue Nile Province appear to be the pink boll worm and the stem borer. Not much is yet known about either the amount of damage that can be done by the latter, or about the best methods of combating it, but the Entomological Section of the Wellcome Research Laboratories is studying the matter carefully.

It is believed that the pink boll worm can be dealt with adequately. The researches of the Government entomologist have made it clear that the sources of infection are infected seed, old cotton stalks, and seed in the houses of the people. All seed issued by us is carefully sunned before issue, and it is certain that this kills off any live worms in the seed. Old cotton stalks are cut out as much as is possible in scattered areas, and it is not thought that the risk of infection from

COTTON BUYING IN NYASALAND

BY

J. ARTHUR LEE

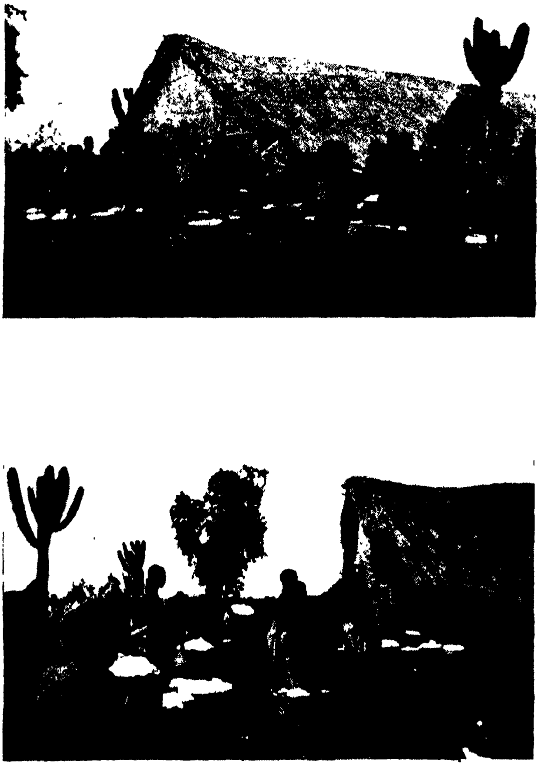
Cotton grown by natives on Crown land is bought in Nyasaland under agreement between the Nyasaland Government and the British Cotton Growing Association, the grower being assured at the commencement of the planting season of the minimum price he will obtain when the cotton is harvested. The planting season varies according to the altitude, but December may be taken as the time for planting in the higher elevations, and January to April in the Lower Shire River districts; the cotton is usually offered for sale towards the end of June, and buying takes place from that month until November.

With an agreement such as the one in force in Nyasaland, the native is assured of a fair return for his labours; he is not in the hands of speculators, who, in the past, have bought his cotton at high prices in boom periods, and have left him with it on his hands when markets were low; this more than anything else was responsible for the falling-off of native cotton growing in Nyasaland. The local native does not understand market fluctuations, and is perfectly satisfied if he obtains a fair and remunerative price for his product. The object of the originators of the scheme was to fix a price to be standard throughout the period of the agreement (five years), any surplus funds after realization on the cotton market being placed in a reserve fund to be used to stabilize prices in the event of a fall in the price on the cotton market.

A season's working of the scheme has resulted in increased activity in native cotton growing in this Protectorate, the natives being more than satisfied with the amount of money obtained, and the writer, in the course of visits to different buying stations, saw their looks of amazement and pleasure at the money they held in their hands; some of them came forward expressing their intention of growing more next season. From 250 native planters in one district in 1923, the number has increased to over 1,500 in 1924.

Markets, or buying centres, are established in the principal villages, but in the large cotton-growing areas, buying stations are fixed at points about 15 miles apart; therefore, the native has not

FIGS. 1 AND 2.—BRINGING THE COTTON TO MARKET.



FIGS. 3 AND 4.—SCENES AT A COTTON MARKET.

To face page 11

at present to carry his cotton more than 7½ miles. As the industry expands, it is proposed to fix the buying stations at 10-mile points.

In order to suit the different temperaments, the system of markets varies somewhat. Some like to bring small quantities in daily as picked, and the market is open from sunrise until a little before midday; in other districts a date is fixed when the bulk of the cotton is ready, and the crop is bought in and finished with in a month. At the latter markets from the first streak of dawn numbers of natives—men, women, and children—may be seen wending their way to the market (Figs. 1 and 2) each laden with various-sized packages on their heads, the average weight of which is about 45 lb., the most popular form of package being made of dried bamboo, the bamboos being laced together with tough broad grass and the ends covered with what looks like chicken netting of the same material. Others bring it in large open and well-made wicker baskets, the cotton being heaped well up over the top and covered with netting also made of grass or strips of palm-leaf; the circular bamboo package is preferable, as the cotton is more completely protected.

The native having arrived at a market, proceeds to sit as near the weighing-scale as possible, and considerable time is often taken, at some of the markets, in getting the mass of natives who have assembled into something like order. At others, in localities where a number of the natives have had military training, something like order prevails, and the buyer on arrival finds the sellers more or less arranged in an orderly queue. It may be explained at this point that, although Nyasaland is a comparatively small country, we have probably a greater diversity of tribes than other countries, and, as cotton is grown from the northern to the southern end of the Protectorate, the customs, manners, and mode of attire are very striking. The natives of the southern end are practically nude, but as one progresses north they are better clothed and more intelligent, the most picturesque being the stately Mahomedan Yaos on the shores of Lake Nyasa.

A buyer, too, gets his Biblical knowledge refreshed when he encounters the natives in the West Shire district, as owing to mission influence they have adopted Biblical names, and the names of the disciples are in greatest favour. This is not the case in the Lower Shire River district, as one comes across male natives with the names of Empress, Princess, and Countess—taken from the names of some of the river steamers.

As to the actual buying of the cotton. The sellers having assembled (Figs. 3 and 4), the buyer proceeds to weigh in, the cotton having been emptied into open baskets 4 × 2 × 2 feet fitted with two wire slings, the tare of which (10 lb.) is legibly stencilled on the outside. The baskets are brought forward to the spring balance by the owner, who gives his name to the native clerk. The buyer, a white man, shouts out the classification, weight, and price per lb., and this is recorded and entered on a numbered duplicate purchasing form, the owner's name, village, and chief's name having already been recorded. The original is then detached and handed to the owner, who retires to the nearest shade and waits until some fifty baskets have been weighed in. The buyer then pays out, while the baskets are being filled again; the seller hands in his receipt and is paid, the receipt also being handed back to him; this is done so that he can, if he wishes, take his money and voucher to the magistrate and get it checked. It will be asked, But how can an uneducated native tell how much he ought to get? The native has a very good idea of what weight he has in his package, and what he received for it in a previous season; if he has grown more or has had a better yield, he makes it up into packages exactly the same size, has them weighed separately, and receives a ticket for each. A variation naturally occurs, but it is only a pound or two, and the owner understands this from the few extra pence he has received over and above the silver money. At one market the writer visited he was surprised to see several natives with ready reckoners, and as the weight and price was called out they jotted it down, and checked the amount on the voucher.

Taken on the whole, the native does not try any fraudulent practices, but the cotton being emptied into open crates makes their detection a simple matter. Occasionally they slip stones into the bulk or hide inferior grades at the bottom; the buyer detects this by running his hand through the contents, and when he withdraws a large stone he presents it to the owner, to the accompaniment of the jeers of the surrounding natives, who do not hide their delight at the culprit having been found out.

The cotton offered is classified into three grades, No. 1 being clean white cotton free from leaf, No. 2 stained and white mixed or white with leaf, No. 3 stained cotton. Better prices are paid for the higher grades, and the natives understand that by grading they receive a better price; the percentage of No. 1 last season was 60 per cent.

The selling of his crop is to the native what a country fair is to the farmers at home, and gives the village something to talk about for some time to come; it also means, after he has paid his hut tax, a visit to the Indian store, where a new cloth is bought for the wife and a shirt for the husband. The purchasing of these often takes a considerable time, as the female natives are quite keen on shopping, and fashions are also in vogue in Nyasaland, certain colours or the pattern changing each season. Once cotton-growing is firmly established, and the native realizes the value of money, more cotton will be grown; the unclothed, after wearing a shirt or a pair of shorts until they are worn out, feel the heat of the sun (the temperature in the cotton-growing areas often reaching 112° to 115° in the shade), which they did not before. Clothing, therefore, will have to be bought, and to get the money to purchase this, cotton will be grown, since this crop is easily the most profitable to them.

In conclusion, a word may be said as to the buyer in charge at the different markets. Where possible, the post is given to a planter or ginner in the vicinity of the market, as he is well known to the natives round him, and will in his own interests do his best to please them. Also being resident there he is more or less certain to give them every encouragement and advice to grow more the following season. Payment to these buyers is made in the form of a commission on the tonnage bought; therefore, being more or less assured of the position, it is also in the buyer's interests to have more produced. His duties in addition to the buying are to see to the bagging and forwarding of the seed cotton to the nearest ginnery. Opportunity is also taken at these markets to encourage better cultivation, and the uprooting and burning of the old bushes after the crop has been harvested; at the conclusion of buying last season, these buyers were appointed inspectors, and they, knowing their district thoroughly, went round and saw that the regulations of the Cotton Pest Act were carried out. These men, who all speak the local dialect, explained in the vernacular the advantages derived by the uprooting and burning of the bushes, and evidence of their work is to be seen this year in the reduction of pests. In short, the cotton buying scheme in Nyasaland interests everyone: the Government are interested, the native gets a guaranteed price with which he is well satisfied, the local planter a share, and also Lancashire gets the cotton it needs.

REPORT ON EXPERIMENTAL WORK WITH COTTON: MPANGANYA AGRICULTURAL STATION*

BY

R. CECIL WOOD

Cotton Specialist, Tanganyika Territory.

SEASONS 1922 AND 1923.

MR. NATTRASS and myself arrived in the Territory at the end of July, 1922. After discussing the general situation with the Director of Agriculture it was decided that we should at once proceed to Mpanganya, in the important cotton-growing area of the Rufiji, where facilities in the shape of the Agricultural Station, in charge of an English-speaking Goanese clerk, were available for the work of seed selection, which was considered to be the most important work we could take up, and for which the season was not too far advanced. We arrived there on August 23. Picking had just begun, and work upon seed selection was started by Mr. Nattrass and myself.

2. The main crop in which selection was done was a field of 35 acres, sown with " Nyasaland Upland " seed. This is the progeny of presumably earlier importations, and it appears likely that it contains traces of admixture with Egyptian cotton, which was cultivated extensively by the Germans. Some sixty plants were selected, and the produce collected separately.

3. On the station there were, besides this field, two other varieties, " Zululand Hybrid " and " Cambodia," the latter an old friend, as it was a unit strain† hailing from Madras. These may be dismissed at once. Examination of the Zululand hybrid showed it to be not only of poor quality, but extremely mixed, and it was decided that this variety was unsuitable for further trial.

Cambodia, on the other hand, showed great vegetative vigour. It had germinated badly, and the field was full of gaps, but the plants

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*** An interesting report, giving a clear picture of the conditions and difficulties under which pioneer work of this kind has to be done.—EDITOR.**

† Madras No. 15, selected by Sampson from a fresh importation from Cochin China, the original home of this cotton.

were remarkably strong and healthy. Seven plants were selected for examination, of which two were planted in 1923. They germinated poorly, and ultimately failed completely. A sample of this cotton sent to England for examination was badly reported on,* and it does not seem likely that it will be of any use to the district.

4. Later in the season a field of very healthy cotton was found at Nyereru, a village some five miles down the river. This was on land that is flooded each year by the river, the cotton being sown as the river recedes. Further selections were made in this field, which was remarkably free from disease.

5. Other general farm work occupied our time at Mpanganya till we left in November. The fields were noted to be somewhat patchy, and trial pits were dug, which showed varying proportions of clay and sand; where there is a fair depth of fine sand or silt, the plants thrive, while where layers of clay occur, the plants tend to dry up prematurely. This subject will be discussed later in this report, as the very dry season of 1923 emphasized these differences in a very marked manner.

Observations were made on the general rate of growth of the crop, and on the methods of cultivation and harvesting. A rough survey of the station was made, and a sketch map prepared. Bolls were collected at intervals, and examined to determine the incidence of insect attack. At the same time, the yellow staining of the lint, which has been so noticeable in the Morogoro district this year, was remarked.

6. For the season 1923 a fairly comprehensive scheme of experiments was arranged in consultation with the Director of Agriculture. I reached Mpanganya on March 17; Mr. Nattrass, my assistant, had been there since February 18.

The season was a most abnormally dry one, as will be seen from the rainfall tables attached. They show the monthly rainfall for this year as well as a record of the fall in the years when the Germans occupied it. It will be seen that the " big rains " were fairly adequate for sowing, but that they did not extend for as long as usual, with the result that the sowing period was curtailed and the land did not get a chance of absorbing enough moisture to carry a full crop. The river reached its highest point, rising about 12 feet, on April 25. Sowing was generally done in time, but much of the station seed which was used for the bulk crop was of poor quality, with the result that large areas had to be resown. This resowing went on as long as there was moisture in the fields, but had to be abandoned before it was completed. Mpanganya seemed to be particularly unfortunate, as the rainfall at Utete, only sixteen miles away to the east, was higher, as it also seemed to be on the west (Table I.).

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* See *E. C. G. Review*, p. 43.

7. This drought was, in one respect, welcome, as it afforded a most rigorous test for the selected strains; the constitution of any strain that has done well this year is beyond question. But it was most unfortunate in another and quite unexpected way. The prolonged drought emphasized unsuspected differences in the soil, and produced a most extraordinary patchiness which affected the whole of the station area. The differences were not only very great, they were extraordinarily well defined, so that adjacent plants would show the most amazing differences; one would be 5 feet tall, and green and leafy; the other would be stunted and wilted, and shedding its leaves. The leafy plants did not, however, produce proportionately more lint, as the bolls opened irregularly and were full of disease; the plants in the dried-out areas ripened the few bolls they produced quickly and cleanly. These differences have largely spoilt the experimental work at the station this year; in a more normal year it is probable that they would show up much less, if at all.

Further examination of the subsoil, made this year, does not provide a full explanation. The ground is composed of patches of sand and clay, thickening and fading out, often in the space of a few yards, and showing by their false bedding that they have been deposited by the river in exactly the same way as can now be seen just off the bank, where a large stretch of sand and silt has this year appeared above the water.

8. SELECTIONS.—As a result of the examination to which the progeny of the single plants chosen as described above was subjected while we were in Dar es Salaam in December and January, thirteen selections, *each representing the produce of a single plant,* were sown this year, receiving letters by which they could be distinguished. In addition one selection was received from the Director which had been made at Bagamoyo by the Agricultural Officer there. Table II. gives some of their characteristics.

These were sown out in F No. 1 at Mpanganya on April 6, in rows each 50 yards long. Five rows was the maximum allowed for any selection; in some cases seed was not sufficient to do this, and fewer rows were sown; in others seed was more than enough, and after filling up blanks and endeavouring to obtain a full stand, the residue was sown somewhere else about the station, separated as widely as possible from any other cotton. The produce of these odd patches was mixed with the produce from the plots; though they were not stitched, it is not considered that there was much chance of contamination.

9. Germination was fair, but not without trouble. The weather was wet at the time and the single seeds had some difficulty in getting through, whereas in other fields where a number of seeds were sown the united efforts of the young seedlings enabled them to push through easily.* The plants were spaced 1 by 1 yard, but this was found to be inadequate, for as the plants grew they suffered considerably from the constant passage of the stitching and picking boys.

10. In order to determine, with a high degree of accuracy, the purity of these unit strains, a careful record was made of ten individual plants in each selection, both in regard to their field characteristics and the quality and nature of the cotton they produced. Ten plants were, at the same time, picked from the unselected material planted in similar conditions at either end of the plot. To allow for casualties, thirteen plants were selected in each case; probably, as they were chosen, and not picked at random, they were, at the time of selection, rather above than below the average plant of the strain. However, the soil conditions soon changed all this, and as the soil became exhausted of water these plants showed very wide differences. Most of the field characteristics, such as the habit and size of the plant, and the number of flowers and bolls produced, have on this account had to be rejected. More reliance has been placed on the colour of the flowers and the anthers, the size and shape of the boll, the weight of the seed, the lint index, and the length of the combed lint.

There were in these selections well over 140 plants on which these observations were made, many of them daily, and it is a matter for great regret that much of this work, which was carried out by Mr. Nattrass and Mr. McEwen, has been rendered useless by the vagaries of the season. However, had these records not been taken, we should have been hopelessly lost, and unable to draw any conclusions whatever. Appendix A shows the blank which was used for keeping these records; it was kindly printed for me by the Government Printer, Dar es Salaam.

11. Flowering began about the first week in July, when a squad of children was engaged to stitch up each morning the flowers that were due to open that day. This work began about 5.30 a.m. and

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* It is probable that this difficulty can be overcome by sowing a single cotton seed with a dozen beans so that they can all sprout together. Afterwards the bean seedlings can be removed. [*Cf.* paper by Mr. Sawhney, below.—Editor.]

continued till about 7.30 a.m., when any flowers not stitched would have opened. Later on, it was found possible in the evenings to stitch the flowers which were due to open the following morning, and the squad worked from 5 to 6 p.m. each day. Aphis appeared in mid-June, and was followed by Meliola; the attack was controlled by soap which was splashed or wiped on the plants. Picking began about the end of July; the plots were picked twice weekly.

12. The observations made on the single plants in each selection, in spite of the irregularity of the soil, possess certain points of interest. Their primary object was to determine the purity of the original unstitched selections made in 1922. There were four characters which it was possible to express mathematically; and these figures were used to work out a single figure indicative of the consistency or purity of the strain. The four characters were:

(1) The weight of 100 delinted seeds.
(2) The lint index.
(3) The percentage of seed to kappas.
(4) The length of lint in the combed seed.

These were determined and the coefficient of variation calculated for each variant. These four coefficients were then averaged, when a direct comparison could be made between the strains (Table III.). It will be seen that all the strains show less variation than the unselected material grown alongside. Among the selections the range of variation is considerable, from 10·36 (L) to 5·28 per cent. (M).

The selections finally picked for expert examination in England, with a view to growing some or all of them on next year, and the data on which this selection is based, are as follows:

Strain.	*Mean of Variation of Four Variants.*	*Length of Lint and Coefficient of Variation.*		*Lint Index and Coefficient of Variation.*	
	Per Cent.	Mm.	Per Cent.	Gms.	Per Cent.
M	5·28	27·3	(2·90)	4·30	(8·03)
H	6·00	26·1	(4·22)	4·44	(6·02)
D	6·30	27·9	(3·76)	4·20	(10·10)
J	8·06	27·6	(4·56)	4·04	(13·00)
N	8·80	29·5	(6·20)	3·72	(13·60)
Mean of all selections	8·20	26·3	(5·81)	4·07	(11·10)

13. M is the best, closely followed by H and D. H is somewhat short, being just below the average, but it may be observed that "combed" length is generally shorter than "pulled" length (Balls,

"Development and Properties of Raw Cotton," p. 182). On this basis a length of 26·1 mm. represents slightly over 31 mm., or nearly 1¼ inches, which is probably quite sufficient if the cotton is satisfactory in other respects. J is well over the average in length, while N has been selected for its length alone, as it is not up to the standard in other respects. It may be suggested that all the above would be the better for further selection, and that is no doubt the case. Two reasons urge me to go ahead with them: one is that it is probable that any of them represents a considerable advance on anything that is at present being grown; the other, that, as will be seen below, the standard of purity, as measured in this way, is not inferior to that reached by some American named varieties, the seed of which was received direct from the United States Department of Agriculture, and sown for the first time at Mpanganya. They may be considered to represent a reasonably high standard of commercial. if not genetic, purity, and if the selections above are up to or above their standard, one is justified in carrying on.

14. AMERICAN VARIETIES.—Seed of the varieties shown in Table IV. was supplied by the Agricultural Department; it had been received direct from the U.S.A. Department, and a little had been sown by the Agricultural Officer near Utete in the previous year. Unfortunately, it was received too late, and thus came to nothing. The balance of the seed, varying greatly in its germination capacity, was sown in F No. 6, four plots to each variety, with a plot of ordinary farm cotton corresponding to each. Figures for yield are valueless; the land showed the same extraordinary variation,* though the site had been specially chosen from the experience of the previous year as a uniform piece. As in the selections, ten plants of each variety and of the local cotton were labelled, and the same observations made on them. The results, in spite of the labour entailed, have been more disappointing even than in the case of the selections, as with few exceptions the plants chosen were in the "wilt" patches. As soon as this was evident, fresh plants were marked to keep up the numbers, but the continuity of the records was, of course, spoilt. It has been possible to come to some conclusions in the same way as with the selections, and Table IV. gives the information available.

Speaking generally, the American varieties have bigger seeds, bigger bolls, a higher lint index, and a higher percentage of lint than the local strain. Their lint is shorter, and rather harsher to the feel, and some of them are quite obviously impure. In Durango four of the plants possessed seed of a greenish colour, varying in intensity; the rest were of the ordinary greyish colour. Green and brown seeds were also found in Trice. The lint of one variety, Columbia, has been sent for examination and trial in England, and to serve as a standard against which the Mpanganya selections can be compared. If it is found that this cotton is really what is wanted, its importation and multiplication on a large scale would offer no difficulty, and would be an easy and inexpensive solution of the problem of the seed supply, in this district, at any rate. A fresh strain of American seed is being obtained this year, and will be sown to serve again as a standard of purity and quality.

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* The yields from these plots show how uneven the land was: four similar plots of one variety yielded 3, 2·75, 2·75, and 13 kilogrammes respectively. Another variety, in plots of the same size, gave 5·75, 10·2, 16, and 19 kilogrammes.

15. The other points recorded may be briefly considered.

(*a*) *Hairiness.*—Practically no difference was noted in any of the plants, which are all recorded as slightly hairy, nearly glabrous, or pubescent, terms with all about the same meaning. One hairy plant was noted in O. The selection has been discarded for other reasons.

(*b*) *Colour of Petal and Anther.*—The colour of the petal was uniformly a creamy white, though a few yellow flowers, possibly indicative of Egyptian influence, were noted in the field. The pollen in most cases was yellow; M had white pollen with one exception, which had yellow pollen; K was the same, but the one yellow-pollened plant was the outside in the row, and it was given the benefit of the doubt. The Americans had practically all white pollen, except Columbia, which had both yellow and white. According to Balls (" The Cotton Plant in Egypt," p. 39), white pollen is characteristic of Upland cottons, while Egyptian cottons have yellow anthers. Further selections will be made in M, in case it proves to be a mixture.

(*c*) *Style.*—This was roughly classified into long, intermediate, and short. Long styles predominate. N is rather mixed in this respect, with two short, seven intermediate, and one long. Lone Star, among the Americans, shows similar variation, with five long and seven short.

(*d*) *Size and Shape of Boll.*—The size was determined by passing the boll through holes cut in a piece of card. The shape was classified as round, intermediate, and pointed. The American varieties are definitely larger than the local selections.

(*e*) *The Number of Flowers and Bolls.*—Had the crop been moderately uniform, some interesting information might have been obtained from the determination of these characters. It would have been possible to check the figures of total yield, and ascertain whether this was due to a heavy production of flowers or a high percentage of setting. Unfortunately, the figures are of little value owing to the variations in the plants.

(*f*) *Days to the First Flower and Boll.*—There is a certain amount of variation, but less than would have been expected. The earliest date at which flowering started was fifty-four days from the time of sowing; the latest seventy-three days. The variation within the selection did not amount, in most cases, to more than a week.

(*g*) *Seed Fuzz.*—This varied with different strains, and to a less extent within the strain. The local unselected seed showed a wide range: two plants produced naked seeds, six greyish fuzz of varying intensity, while one plant produced greenish-coloured seeds, and another brown. O produced two green seeded plants, these being of a particularly vivid colour. For the rest, the variation was in the amount of fuzz carried on the seed.

(*h*) *Weight of* 100 *Seeds.*—This was determined by calculation from a number of seeds ranging from 50 to 150, according to the amount of seed cotton available. The seeds were delinted by hand, and there was probably a slight error introduced by the workers who did this. The Americans produced noticeably heavier seed, with a mean of 11 grammes to the 9·36 of the selections. All these are heavier than the local cotton, which only reached 8·04.

(*i*) *Lint Index.*—This is the weight of lint obtained from 100 seeds, and the variations in this follow naturally much the same course as the weight of the seeds. The Americans are easily the highest, Northern Star being credited with 7·52 grammes; the lowest is N with 3·72.

(*j*) *Percentage of Lint to Seed Cotton.*—An important figure from the buyers' and ginners' point of view, since the seed in many parts of the country is worthless, owing to the difficulties of transport, while in any case it is worth much less than the lint. The Americans have the best record, with the astonishingly high figure in the case of Lone Star of 39 per cent.

(*k*) *Length of Lint.*—This was measured on the combed seed. In 1922 the whole seed was combed; in dealing with the 1923 crop only one side of the seed was combed, as suggested by Hilson (Bull. 138: A.R.I., Pusa), with considerable saving of time. There is some difference of opinion as to the exact point from which measurement should be done. Hilson places "the point of the arm of a pair of dividers on the median line at the point of origin of the hairs, along which measurement is to be made." Balls brings one leg of the dividers "up against the butt of the seed," thus getting a proportionately lower reading. In this year's work I adopted the latter method, placing the leg of the divider against the seed in the line of the hair, usually between 4.30 and 6 o'clock. Three combings were made by each of us—six combings for each sample. There was distinctly less variation in regard to this variant in each selection than in others.

PROGRAMME FOR THE SEASON 1924.

16. Some or all* of the five strains mentioned above will be grown on this year, though I am not anxious to have more than three for further trial. One set of plots will be grown for definite comparison of the strains as to yield, maturity, and field characteristics generally. No stitching will be done, and the seed from these plots will be discarded. The rest of the seed of the strains will be sown in multiplication plots as economically and as remote from each other and from any other cotton as possible. The seed from these plots will be used for further extension.

17. FRESH SELECTIONS.—It is not considered that a single year's work is likely to exhaust the possibilities of improvement, and it is realized that the process must be a continuous one, so that each year there should be found on the station (*a*) a few marked and stitched plants, the selections of the year; (*b*) small plots stitched, being the progeny of the selections of the previous year; (*c*) comparative *and* multiplication plots of the strains selected two years before; (*d*) bulk plots of seed, possibly of only one or two strains, being grown on for district distribution.

This year Mr. Nattrass marked five new plants. Three of these have been kept for further trial. One is a plant which produced no monopodial branches at all; it is not a particularly good quality, but is worth persevering with, as if its habit persisted it might be useful as a parent in a cross. The other two plants are of first-class quality. Besides these, seven of the single plants marked and stitched in this year's selections will be grown on as if they were fresh selections. The ten plants are P, Q, and R, the three new selections, and C1, D1, D2, J1, K1, N1, and N2. One newly imported American will be sown as a standard of purity.

CULTIVATION EXPERIMENTS.

18. TIME-OF-PLANTING EXPERIMENT.—Cotton, in this as in other districts of the Territory, is not an established crop, and consequently there is no tradition as to the correct time of planting. Attention has, therefore, been given to this question, and on my arrival at

* Depending on the report received about them.

Mpanganya last year I found that a time-of-planting experiment was already in progress (see Annual Report of the Department of Agriculture, 1922). Further experiments were arranged for this year, but, though they looked satisfactory, with one small exception, when I left in June, they began soon after to display the extraordinary variations I have mentioned above, and the figures are therefore mostly valueless. Two sets of experiments were carried out, called roughly "natural" and "artificial." In the natural series the plots were sown on their appointed days, whether or no it was considered likely that they would germinate at once or subsequently, and no filling was done. In the artificial series use was made of hand watering to give the seeds a start where necessary, and enable them to get their roots down to the subsoil water, after which they were left to themselves. Gaps were filled and watered, in an endeavour to obtain a full plant.

It is difficult to know what to report about these experiments. Taking the figures alone, the earlier plots have, on the average, given the highest yields in each case, and the smallest proportions of second-grade cotton; but the duplicates are so discordant that the probability of these figures meaning anything at all is very doubtful. The earlier sown plots made the tallest growth, but being the only cotton growing at the beginning of the season, they naturally attracted to themselves various insect pests, which afterwards moved off to the other plots as they ripened in succession. The plots in F. No. 1, "Artificial Series," suffered the most from irregularities of soil; a typical inspection note is quoted:

> "*September* 4, *Plot* 1.—Growth has now almost ceased in the very luxuriant plot in the centre; leaf fall has commenced . . . on either side the plants are practically dead. Plot 1A.—Outside edge . . . still green . . . bolls set right up to the top of the stems . . . remainder bare stalks."

19. My own opinion, which I put forward with considerable diffidence, is that in many cases—I should not like to say all—planting is done too early. The trouble with much of the cotton, not only in this but in other districts, is that it tends to go on growing, and is not definite enough in its reaction to its environment. This weakness seems to me to be emphasized when the cotton is grown too early, as the plant becomes overgrown and rank, and is less inclined than ever to devote its energies to producing a simultaneous crop of flowers and ripening them off quickly and uniformly. The remedy for this would seem to be in the evolution of a type which will stop growing

and produce its lint in about six and a half months, instead of straggling on, as the plants in these experiments do, for eight or nine months. If this was sown as late as possible, it should be more uniform in its production of bolls than the present crop in most cases is. No grower will run the risk of waiting too long to sow, but it would be possible to do a second sowing between the rows if good rains were received subsequent to the last sowing. Seed at present is plentiful, there being no demand for it in many places.

20. Besides these two series of plots, other experiments of a simple nature were carried out to elucidate other points in doubt. Such, for instance, was a simple comparison of various spacings, which failed, owing to the irregularities of the land.

21. A similar trial was carried out to see whether the crop could be sown in a continuous line, as if with a drill, and left close in the row, in order to discourage the production of vegetative side branches on the lines of what has been called "single stalk culture." The experiment showed that it is perfectly feasible to plant in this way, and in one corner of the plot where there was a normal yield it was reported that there was quite a tendency for the suppression of monopodial (vegetative) branches.

22. An experiment to judge the result of topping the plants was carried out in No. 1, and this was more definite in its results. For one thing the land proved to be fairly even, and for the other, a comparison can be made between five individual rows, which were topped, alternately with five which were untopped. The average yield of the plants left untopped is 22 per cent. above the topped plots with a standard deviation of 9·6 per cent., so that the difference between the plots may safely be considered significant, and the experiment will not be continued. It is interesting to note that this does not bear out German experience, which is reported to have attributed an increase of 12 per cent. from topping the plants (*cf.* EMPIRE COTTON GROWING REVIEW, January, 1924, p. 45).

23. CAGE EXPERIMENT.—A great deal of damage is done to the cotton not only of this Territory, but also of Nyasaland (see Sampson's Report) and of Uganda, where I have seen it myself, by a yellow stain, the origin of which is not yet absolutely clear, though the damage it does is well known. It is probably due to the action of insects, which puncture the bolls and thereby introduce the organisms responsible for the staining and weakening effect suffered by the lint. In an attempt to throw some light on the problem, two cages were constructed, roughly 6 by 6 by 3 feet, and fitted with mosquito gauze. These were placed, each, over two plants in the field, on

July 7, before the bolls showed signs of forming; the plants were of normal habit and, at the time, about 2 feet high. Subsequently at intervals throughout the growing period of the cotton numbers of the red cotton bug and the dusky bug were introduced into one of the cages, the other being kept as the control. Trouble was experienced with aphis, which were kept in check by soap treatment, but the ants proved more troublesome, for they continually climbed the plants and removed the stainers that had been introduced, and fresh lots of stainers had to be introduced at frequent intervals.

The results are extremely suggestive. Sixteen bolls were collected from the control cage, not one of them being stained; out of thirteen bolls taken from the infected cage, ten were stained and one was unhealthy. The experiment will be repeated in the coming season.

24. Counts were made again to determine the degree of the boll worm attack. The pink boll worm is the most common here, and even of this there was little until October. The percentage rose from 5 per cent. on September 8 to 20 per cent. on the 22nd, while on October 5 a count showed over 50 per cent. and a few spotted boll worm.

PROGRAMME FOR THE COMING SEASON.

25. The time-of-planting will be continued this year, but greater precautions will be taken to reduce the probable error by increasing the number of plots. As previously, there will be two series, " natural " and " artificial."

An experiment will also be started to test the effect of deep cultivation on these lands. At present, no cotton ever gets more than the most superficial scraping, and it might be expected that deep cultivation would lead to an increase in the yield. The matter is complicated by the habit of the plant referred to above, and I think it quite likely that over-conservation of moisture is a possibility. The high prices obtaining for cotton this season will undoubtedly stimulate its cultivation by natives, and the labour available for estate cultivation will presumably diminish. Where cattle are not available, the only alternative is power cultivation, which was practised on more than one estate by the Germans, but I should like to know more about the effects of deep cultivation before I recommended the investment of capital in this way.

GENERAL REMARKS ON THE COTTON AT THE STATION.

26. It was most unfortunate that two accidents prevented the station from making a really good show this year. The first was the exceptional season, and the second was the poor quality of the seed

available. In a more normal season the failure of some of the seed to germinate could have been remedied, but by the time the real cause of the trouble was discovered it was too late to resow much of the land. Even the fields which started well rapidly dried up.

27. Much of the seed was treated before sowing with a mixture of clay and water, so that the fuzz was smoothed down, and the seeds slipped easily through the hand. The process offers no difficulty, but should be done shortly before sowing or else the seed must be rapidly dried (see p. 13 of Sampson's report). It is also effective to soak the seed for sowing overnight, as this helps to produce more rapid germination.

28. All the fields were sown in lines. This facilitates observation and the checking of the daily tasks of the workmen. The method adopted was to mark out the land with an implement designed for the purpose, based on the South Indian bullock drill. This was dragged over the field by a gang of men, the sowers coming behind, dropping the seed into small holes made at intervals along these lines. Mention has been made above of the possibility of dropping the seed continuously along a furrow such as could be made by a slightly heavier type of marker, and this will be investigated next year.

29. As much cultivation was given to the land as was possible, but it required constant supervision to emphasize the difference between " kulima " and " kuchimba," the latter being a much more thorough performance. Picking was carried out this year mostly by adult Wangoni, for whom employment had to be found. They are poor pickers, and it is seldom that they pick more than 20 lbs. a day, unless the crop is flushing exceptionally freely; the best figure obtained was 30 lbs. Last year, when children were employed, the daily picking ran to 14 lbs. or so, at half the cost.

30. The question of sorting, whether it is better to do this in the field at the time of picking or later, after the cotton has been received in the store, is still unsettled. It depends on the skill of the picker, and the amount of stained and dirty cotton. The younger boys can do it fairly well in the field, but the amount picked drops as soon as separation in the field is attempted with the adult Wangoni.

Further observations on this point will be made in the coming season.

TABLE I.—RAINFALL: MPANGANYA AND UTETE (MILLIMETRES).

Year.	1911.	1912.	1913.	1923.	1923. (*Utete*).
January	41·0	161·8	134·8	—	—
February	83·6	226·0	104·7	—	—
March	78·0	187·2	303·1	50·7	22·0
April	234·3	139·7	223·0	159·4	188·8
May	24·8	36·0	14·8	18·2	17·8
June	0·2	11·3	15·3	2·9	10·0
July	5·0	6·9	2·2	2·2	7·8
August	—	4·1	17·5	4·1	18·4
September	1·0	1·5	0·3	0·7	—
October	8·5	5·4	4·9	7·1	—
November	63·6	94·0	130·9	52·8	—
December	120·7	24·0	39·4	—	—
Total	660·7	897·9	990·9	—	—
Inches	26·8	35·3	39·0	—	—

TABLE II.—SELECTION OF 1922: MPANGANYA.

Original Number.	*New Letter.*	*Length of Staple.*	*Lint Per Cent.*	*Lint Index.*	*Weight of 100 Seeds.*
		Mm.	Per Cent.		
8	A	26·1	29·1	3·9	9·4
20	B	25·5	27·5	4·3	11·4
21	C	27·1	29·2	4·7	11·5
22	D	27·9	28·1	4·3	10·6
40	E	26·3	28·3	4·1	10·4
48	F	25·5	27·4	4·7	12·9
94	H	26·3	31·1	4·7	10·5
95	J	28·7	28·0	4·0	10·3
97	K	26·2	28·7	5·0	12·4
99	L	28·4	28·8	3·9	9·6
100	M	27·5	29·4	4·6	11·0
92	N	29·0	29·5	4·7	11·2
—	O	24·0	32·4	4·8	10·0

TABLE III.—SELECTIONS 1923, MPANGANYA: RESULTS OF EXAMINATION OF TEN PLANTS IN EACH SELECTION.

Number.	*Length of Staple.*		*Lint Per Cent.*		*Lint Index.*		*Weight of 100 Seeds.*		*Mean Variation.*
	Mean.	Variation.	Mean .	Variation.	Mean.	Variation.	Mean.	Variation.	
	Mm.	Per Cent.	Per Cent.	Per Cent.	Gms.	Per Cent.	Gms.	Per Cent.	Per Cent.
A	24·4	11·80	31·8	4·97	3·87	13·70	8·52	9·52	9·82
B	25·1	5·12	28·8	7·54	4·10	7·20	10·10	7·90	6·94
C	25·7	4·70	30·7	9·80	4·30	14·70	9·70	9·30	9·52
D	27·9	3·76	30·8	3·96	4·20	10·10	9·50	7·50	6·30
E	26·8	5·10	29·0	7·10	3·70	10·40	9·00	5·25	6·96
F	Material insufficient for full determination.								
H	26·1	4·22	30·9	6·48	4·40	6·02	9·90	7·30	6·00
J	27·6	4·56	28·7	8·90	4·00	13·00	10·00	5·80	8·06
K	26·0	7·40	30·3	7·80	4·10	9·65	9·40	9·75	8·65
L	26·2	3·50	30·4	12·30	4·00	11·75	10·10	13·90	10·36
M	27·3	2·90	30·2	4·20	4·30	8·03	9·90	6·00	5·28
N	29·5	6·20	28·9	6·80	3·70	13·60	9·10	8·90	8·80
O	23·6	11·20	31·8	4·00	4·10	14·80	8·80	17·00	11·70
Unselected	24·0	8·90	32·8	16·00	4·00	13·00	8·00	15·00	13·20
Average*..	26·3	5·81	30·2	6·40	4·10	11·10	9·60	9·00	8·20

* Excluding the control of unselected seed.

TABLE IV.—AMERICAN VARIETIES: MPANGANYA, SEASON 1923.

OBSERVATIONS ON TEN PLANTS IN EACH VARIETY.

Name.	*Length of Staple.*		*Lint Per Cent.*		*Lint Index.*		*Weight of 100 Seeds.*		*Mean Variation.*
	Mean.	Variation.	Mean.	Variation.	Mean	Variation.	Mean.	Variation.	
	Mm.	Per Cent.	Per Cent.	Per Cent.	Grms.	Per Cent.	Grms.	Per Cent.	Per Cent.
Trice ..	20·2	4·5	33·2	6·7	5·1	13·4	10·3	12·0	9·2
Lone Star	(22·7)*	(12·5)*	39·0	4·5	7·5	9·5	11·8	14·6	10·3
Acala ..	23·3	6·8	36·0	5·3	5·9	17·3	10·5	19·0	12·1
Durango ..	24·1	7·5	35·4	7·3	6·0	7·9	11·0	13·3	9·0
Columbia	26·8	6·6	31·3	4·5	5·2	21·4	11·5	19·3	12·9
Average ..	23·6	6·3	34·9	5·6	5·9	13·9	11·0	15·6	10·3
Local unselected	23·6	4·4	32·1	7·2	4·21	13·0	8·9	9·6	8·5

* Only five individuals and not included in the average.

APPENDIX A.—FORM USED

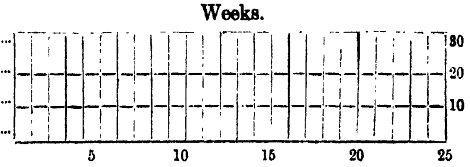
SEASON.................................PLANT NO.................................

Notes on parent:—

Branching Habit.

Date of sowing..
Seeding condition ....
Adult condition ....
STEM: Height .... LEAF: Shape ....
Colour .... Hairiness....................
FLOWER: Colour of petal .... Style ....
Colour of anther....................

Date of first flower ....
BOLL: Shedding % ....Size of boll ....
Shape of boll ....
No. of locks per boll ....



No. of seeds per lock..
SEED: Fuzz..
Weight of 100 seeds ....
LINT: Yield in grammes:— ....
Length .... Colour .... Strength ....
Lint Index .... $\frac{\text{lint}}{\text{kappas}}$ ....

	FLOWERS.								BOLLS.							
	M.	T.	W.	Th.	F.	S.	Su.	Total.	M.	T.	W.	Th.	F.	S.	Su.	Total.
5																
10																
15																
20																
25																

THE WORK OF THE IMPERIAL BUREAU OF MYCOLOGY

BY

E. J. BUTLER, C.I.E., D.Sc., M.B.,

Director.

The serious study of the depredations caused to cultivated crops by parasitic fungi and bacteria dates from comparatively recent times, and it was not until after the beginning of the present century that any organized attempt was made to ascertain the cause and seek methods of prevention of crop diseases in the tropical and subtropical parts of the Empire. As agricultural departments were established in the various dependencies, officers were appointed who were charged with the duty of investigating the diseases of plants and devising means for their prevention or control. These officers are usually termed "mycologists," though the names "plant pathologist" or "phytopathologist," used in other countries, more aptly describe their functions. There are not far short of 100 such experts at present at work in the overseas parts of the Empire, all, with very few exceptions, attached to Government Departments of Agriculture.

In some cases these workers enjoy facilities not inferior to those available in the best equipped laboratories and research stations in England. In others, and this applies particularly to the tropical areas, certain facilities are poor. The chief lacks in such cases are a good library and access to authentic specimens of the parasites known to cause disease in plants. There is nothing more discouraging than to find that work which has cost much time and labour has already been done somewhere else, or that a supposed new parasite has previously been studied and its ways are known. Even in the best equipped centres it is difficult to keep pace with the mass of research and practical work that is going on in many parts of the world, and to see and find time to read all the publications (many in obscure journals or difficult languages) that have a bearing on one's work.

In the past, assistance in such matters was provided by the Royal Botanic Gardens, Kew, and the British Museum of Natural History at South Kensington. Germany had carried the systematic study of the subject beyond the point reached by any other country, and German assistance was almost indispensable to the overseas worker. With the outbreak of war the inadequacy of these arrangements became painfully evident, and both in England and in the dependencies means were sought to satisfy the requirements of the scattered band of mycologists throughout the Empire. The Imperial Bureau of Mycology was the result.

The Bureau was founded in consequence of a resolution of the Imperial War Conference passed on July 8, 1918. The subject was brought to the notice of that body by the Colonial Office, which, impressed by the success which had attended the efforts of the Imperial Bureau of Entomology, founded five years earlier to meet a similar situation in regard to insect pests, thought that the time had come to establish a like organization to deal with the other great class of destructive agencies in agriculture—namely, the diseases of plants caused by fungi. A number of the overseas Governments expressed their readiness to contribute to the support of the Bureau, and work was eventually started in September, 1920. The affairs of the Bureau are managed by an honorary committee appointed by the Secretary of State for the Colonies, with Earl Buxton, G.C.M.G., as Chairman. Its finances are on a temporary footing, and negotiations are in progress to extend them for a period of five years from April 1, 1925.

The work of the Bureau falls naturally into two main divisions: it serves as a clearing-house for information on all aspects of plant pathology other than those concerned with insects and the like, and it examines and reports on specimens sent in from all parts of the Empire.

As a centre for information the Bureau endeavours to keep in touch with the work on the diseases of plants going on throughout the world. A staff of linguists is engaged in reading all the literature on the subject published in any part of the world to which access can be had, and in making abstracts of all original papers. These abstracts are printed monthly in a journal published by the Bureau, the *Review of Applied Mycology*. They are given in sufficient detail to enable workers in many cases to dispense with reference to the original paper, and are issued sufficiently promptly to keep up a survey of current activities in the whole field of plant pathology. The monthly numbers at present contain from 100 to 120 abstracts, and the volume for 1924 runs to 752 pages, exclusive of the index. The latter is in great detail, as the value of an abstracting journal in after years depends on the readiness with which references to particular matters may be looked up. No attempt is made to secure a satisfactory balance-sheet in regard to the *Review:* to do so would be impossible without charging a prohibitive price per copy, as the circulation is practically limited to the comparatively few who are directly interested in the subject. Hence an appreciable proportion of the Government grants is applied to the production of the *Review*, and copies are supplied free of charge to all the contributing Governments for the needs of their departments. At the recent Imperial Mycological Conference, held in London last July, a resolution was passed expressing appreciation of the service rendered by the *Review* to all workers on the subject, especially those in the overseas parts of the Empire. It is probable that no branch of the work of the Bureau has been more widely approved than the publication of this journal, and its reception has been scarcely less cordial in America and on the Continent than within the Empire.

Another aspect of the information service is the furnishing to enquirers of references regarding previous work on a problem. In order to deal with such enquiries the Bureau aims at keeping up a comprehensive card index to the literature on plant diseases, and, in addition, maintains a large lending library of original papers in pamphlet form available for issue on demand. This library numbers over 6,000 items, cross-indexed by subject and author, and is increasingly being made use of by overseas mycologists. Extracts and translations from publications not easily available are also asked for at times, and requests for information of one kind or another are received in considerable numbers, almost by every mail. Recently a demand has arisen for copies of sections of the subject card index to be made available for some of the larger departments, and these are being issued at cost price.

The examination of, and reporting on, specimens sent from overseas is the second main activity of the Bureau. Progress in this branch of mycology is less advanced than in regard to insects. The fungus flora of a great part of the British tropical and subtropical dependencies is not well known; an enormous amount of work remains to be done before an adequate account could be given of, say, the fungi of tropical Africa. Plant disease surveys have been undertaken in some areas, but these are, as a rule, confined to recording the diseases which cause notable damage to important crops. Unfortunately, a parasite that may be inconspicuous and relatively harmless in one area may cause a major disease in another. Many years ago the writer collected an insignificant leaf-spotting fungus on cotton in Kashmir which proved to be new to science. Nothing more was heard of this until, in 1920, a severe outbreak of a new disease of cotton was reported from Arkansas, and on investigation was found to be due to the same fungus. How it got from Kashmir to Arkansas (or *vice versa*), and what countries in between it affects, are not known, but it is evident that every record of its distribution would be of importance.

Within the limits of the capacity of its small staff the Bureau tries to aid in gaining a more detailed knowledge of the fungi of the colonies. In some, such as Ceylon, little or no outside help is required, for such knowledge is already far advanced. In others, intensive collection is much needed, and it will be many years before the survey is completed. The number of systematic specialists available for the study of these collections in England is small, and progress is likely to be slow even with the aid of foreign workers.

In addition to this general systematic work a large amount of time is devoted to the examination of individual specimens, often of obscure diseases or of parasites whose identification is difficult. In regard to this part of the work the position of the Bureau is somewhat like that of a consulting physician, except that it does not aim at dealing with all such enquiries itself, but passes many of them on to other specialists. In every case the idea is to get the best advice available, whether in England or abroad. The organization of the information side of the work is called into service here, since it is through the latter that the Bureau keeps in touch with active workers in various parts of the world and is usually in a position to know at any given moment who are working on any disease or group of fungi that the specimen may belong to.

A couple of cases illustrating this branch of the work can be taken from enquiries regarding cotton diseases that have been dealt with during the past year or two. The outbreak of black arm disease, caused by *Bacterium malvacearum*, in the Sudan, is one of the serious problems which the Sudan Plantations Syndicate has to face. The Bureau has been in close touch throughout with Mr. R. E. Massey, the Sudan Government Botanist, in whose hands the investigation of this problem is placed. The first isolations of the parasite were sent to the Bureau to confirm its identity with *B. malvacearum*, and new cultures made from these were transmitted to Dr. Erwin Smith at Washington, the original describer of the parasite. He tested it fully, and reported that it was a variety of this organism, which was known also in the United States, but had not been described in detail. It is probable that without such an authoritative opinion there would still be doubt whether the disease was really black arm. Furthermore, the search for a satisfactory method of disinfecting the seed has been aided by the Bureau putting Mr. Massey in touch with institutions and firms most likely to be of assistance to him. The recent promising trials of izal against the same disease in the West Indies were arranged entirely through the Bureau. The prevalence of black arm in Nigeria has just been reported to the Bureau, which is thus in a position to put the local mycologist in direct touch with practically all that is known about it elsewhere.

A second interesting case is concerned with an obscure fungus which has been known to attack cotton and other plants in India for a number of years. More recently Mr. Briton-Jones, the late Mycologist to the Ministry of Agriculture in Egypt, found a similar fungus injuring cotton in that country. Dr. Shaw of Pusa, India, suggested that the Bureau should compare the parasite with a fungus, *Sclerotium bataticola,* which attacks sweet potatoes in the United States. Cultures of the Indian, Egyptian, and American fungi were grown side by side at the Bureau and proved to be identical. The curious thing is that the fungus has not been reported on cotton in America, while in the other countries it has not been found on sweet potatoes. Quite recently all three strains have been tested on sweet potatoes in Uganda, and all were found to rot the tubers just as described in America. In Uganda the same fungus infects beans, and will doubtless be found on cotton too, while from Nigeria it has recently been received on cotton and ground-nuts.

It can easily be realized that a single enquiry of the nature of those mentioned above may occupy several months and involve, in such cases as the last, a good deal of laboratory research. Apart from this kind of work, however, the Bureau does no original research, since it has always maintained the view that research into the cause and control of plant diseases must be done on the spot.

While the Bureau, for obvious reasons, works as a rule through the local departments of agriculture, its services are freely available to non-official mycologists. These are unfortunately few as yet, but the example set by the Indian Tea Association, the Rubber Growers' Association, and a few large corporations such as the Colonial Sugar Refining Company in Australia, in maintaining their own research staffs (including mycologists), is worthy of wider imitation. The existence of the central organization outlined above will undoubtedly make such a policy easier to adopt, and will smooth the path of the individual workers in small, isolated scientific centres, such as one may hope will be founded in increasing numbers by the plantation industries in the overseas parts of the Empire.

THE SOILS OF TROPICAL AFRICA*

BY

E. M. CROWTHER

Soil Physics Department, Rothamsted Experimental Station, Harpenden.

An enquiry has reached the Soil Physics Department of the Rothamsted Experimental Station from one of the African cotton-growing centres as to the nature of laterite soils and the reasons for the lack of correspondence between the soils and the underlying geological formations. As the subject is of considerable importance to tropical cultivation, the following information may prove of interest to cotton growers, and may indicate the type of observations and experimental work needed for a classification of soils that will facilitate the extension of cotton-growing experience into new regions.

Geological maps represent either the underlying rocks or surface accumulations produced by weathering from these or other rocks. Such surface accumulations, however, are not soils in the agricultural sense, but simply the parent material from which soils are ultimately evolved by the prolonged action of climatic forces acting either directly, as a continued "weathering," or indirectly, through the agency of living organisms. A soil is essentially the product of two factors; it is the resultant of the action of climate on rock material, and the resemblance of the soil to its parent material will decrease with the "ageing" of the soil. In the British Isles the climatic factors are not extreme, and the indirect action of climate through a characteristic vegetation has been interrupted and modified by the replacement of a native forest covering by prolonged cultivation. In a certain sense the soils thus remain immature, and show a close correlation with the surface accumulations from which they are derived. Under these conditions the geological map forms a useful basis for soil classification, and, indeed, the converse holds, for the geologist frequently uses changes in soil type for fixing the boundaries of the various formations.

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* This article is based in part on "The Vegetation and Soils of Africa," by H. L. Shantz and C. F. Marbut, American Geographical Society Research Series, No. 13, New York, 1923. This monograph is accompanied by large-scale maps illustrating the distribution of vegetation, soils, land classification, and rainfall of Africa, and contains an extensive bibliography.

Under the characteristic continental climates of the great land masses the more important factors in weathering—viz., rainfall and temperature—become greatly intensified, and in undeveloped countries the direct climatic effect is supplemented by the important action of a characteristic native vegetation. The existence of great belts of similar climate tends to produce corresponding soil belts. The suggestion that soil classification should be based on climatic rather than on geological considerations was first advanced by Russian workers from a study of the distribution throughout Russia and Siberia of the black "Chernozem" soil. This soil is characterized by its dark colour and zones of calcium carbonate accumulation in the subsoil, and has had a grass covering throughout a long period of time. The soil differs completely from the black soils of England, which invariably indicate excessive moisture and the need for drainage, in that it is found only in relatively dry districts, with a rainfall between about 16 and 20 inches. The nature of the underlying geological formations has but little effect on the essential properties of this soil, so that the conclusion is inevitable that the chernozem soil is essentially the product of climatic forces acting directly and through the medium of the native vegetation. Some half-dozen other soil types were recognized by the Russian workers, who developed a genetic or climatic classification of soils. This classification has been extended to other continents, notably North America, with the recognition of three or four further broad soil types.

It is probable that a similar belted distribution of soils will be found throughout Africa, but the existing information is so meagre that only the broadest indications of the essential soil types and their boundaries can be given at present. The most striking feature of the soils of Central Africa is their reddish colour, and the term "laterite" has been widely applied to the characteristic red soils found in tropical regions with high rainfall. Originally the name "laterite" (Latin, *later*, a brick) was given by Buchanan in 1807 to a red surface material which hardened on exposure to air, and which was therefore used as a substitute for bricks by the natives of India. Throughout last century no precise definition of the term was possible. The Indian geologists distinguished between "true" or "residual" laterite, which contained definite concretions of iron oxide, and "detrital" laterite, without concretions and regarded as a sort of alluvium derived from the true laterite.

More recent geological studies on laterite have resulted in a precise definition in terms of chemical analysis. The essential characteristic of laterite is not the red colour due to the presence of iron oxide, but the presence of large amounts of aluminium hydroxide. In the soils of temperate regions the aluminium occurs either as complex aluminosilicates in disintegrated fragments of the original rock minerals, or as an aluminium silicate, such as a kaolin, produced by weathering. In laterites which are formed at a high temperature and under heavy rainfall, the silicates are decomposed and the silica is either leached away or separates out as quartz. On account of the almost universal presence of iron in rocks, most laterites contain hydrated iron oxide which gives the customary red colour, though it is quite possible for a light-coloured laterite to be formed from rock devoid of iron. The nature of the original mineral determines only the impurities associated with the laterite. Bauer in 1898 studied the transformation of granite, diorite, and sandstone into laterite, and showed that the aluminosilicate minerals changed progressively to hydrous aluminium hydroxide in flakes retaining the original structure of the mineral, with the cavities filled up with ferric hydroxide or quartz.

Recent work by Campbell has shown that laterite formation is not a simple change, but takes place in two broad stages. The first occurs in a zone of permanent saturation with water, and gives a hydrous silicate of aluminium by the action of processes identical with those usually operating in temperate climates. This is followed in regions of high temperature and heavy rainfall by a second characteristic type of weathering in a zone of intermittent saturation, and silica is removed from the aluminium silicates, leaving aluminium hydroxide. The two stages involve a prolonged succession of changes repeated many times, so that the ultimate composition of a laterite may bear no relationship to that of the unaltered rock which originally occupied the same space, but may be determined entirely by external agencies. In any region it is probable that soils may be found to represent most of the stages between the freshly disintegrated rock and the completely weathered product. A precise definition of laterite may be given in terms of the completeness of the formation of hydrated aluminium hydroxide, or other essential laterite constituents, such as the hydroxides of iron, manganese, or titanium.

It is obvious that the study of African soils is not sufficiently advanced to permit any detailed classification and mapping of the soil types. A preliminary step has, however, recently been made by C. F. Marbut, from a review of the literature, supplemented by the complete analysis of some dozen samples collected by H. L. Shantz in the course of a survey of the vegetation of Africa. Marbut's classification and map are based on a whole-hearted acceptance of the theory of the climatic and topographical classification of soils, and many of the dividing lines are drawn quite frankly from the rainfall map. In his treatment of the red soils of Central Africa, Marbut follows the geologists Fermor and Lacroix, in restricting the term " laterite " to soils containing, after elimination of the quartz, more than 90 per cent. of the essential laterite constituents. Soils with between 25 per cent. and 90 per cent. of these constituents he terms " lateritic red loams," and all other soils of similar type are called simply " red loams."

The heavy rainfall, essential for the production of laterite, results in an extensive removal of alkalies and alkaline earths, and washes the finest particles down into the lower depths of the soil. Laterite soils generally show, therefore, a light or sandy surface soil resting on a relatively heavy subsoil. In the red loams the leaching has not progressed so far, and the soils are generally richer in plant food and more fertile. On the mountain and hill slopes of Central Africa—*e.g.*, north of Lake Nyasa and in Tanganyika Territory—erosion of the soil occurs before the leaching and compacting of the subsoil have progressed far, and the soil is constantly rejuvenated, remaining more uniform in texture and more fertile.

The soils of the drier belts surrounding the laterites and red loams are classified by Marbut as of the Chernozem type. Here the rainfall is just sufficient to maintain a luxuriant growth of grass, which adds to the soil a large amount of organic matter in the form of roots. This material is readily decomposed by the action of micro-organisms to humus, with the formation of large quantities of carbon dioxide, which produces calcium carbonate by its solvent action on the soil minerals. The rainfall is insufficient to leach out the calcium carbonate, which therefore accumulates at varying depths in the subsoil and is effective in preventing an extensive removal of organic matter, so that a black surface soil of the Chernozem type is formed. In regions of still lower rainfall the surface vegetation is less luxuriant and less humus is formed, whilst the calcium carbonate accumulates nearer the surface, giving the Chestnut Brown soils of the Russian investigators. In both these types the lower rainfall reduces that accumulation of clay in the subsoil which is characteristic of the wetter regions, so that deeper and more uniform soils of a granular texture are produced.

The development of a sound classification of the soils of a continent such as Africa, and the production of maps showing even the approximate distribution of the principal soil types over wide areas, will need the collaboration of large numbers of workers over long periods, but at present there are vast areas in which there is no information beyond the fact that the soil is red. For the accurate definition of soil type it is necessary to have not the approximate estimation of total amounts of plant food contained in the soil, but a complete analysis of samples from various depths, showing the total amount of the principal alkali metals and alkaline earths, aluminium, carbonate, combined water and combined silica. Such analyses are laborious, and can obviously be made only in laboratories possessing exceptional facilities. Fortunately, much useful information can readily be obtained in the field by observations on the nature of the soil at various depths. The darkness gives an indication of the amount of organic matter, whilst the uniformity of the colour shows the extent of drainage and aeration, and the depth of the weathering may be estimated from the colour changes due to oxidation of the iron compounds. The presence of calcium carbonate is readily ascertained, and its accumulation in zones at varied depths or, if the original rock material contains it, the depth from which it has been removed, plays an important rôle in the determination of soil type. Accurate observations of this type, especially in the undeveloped regions, would provide the material for constructing useful soil maps, after the soil types had been established by detailed analyses of a number of carefully selected typical soil samples.

SUMMARY OF ENTOMOLOGICAL PROGRESS REPORTS (AUSTRALIA)

RECEIVED FROM

E. BALLARD

Cotton Entomologist appointed by the Corporation, attached to the Commonwealth Government of Australia.

BRISBANE, *April* 28, 1924.

SHORTLY after his arrival in Queensland in April last, Mr. Ballard made a tour of the coastal areas in order to get an idea of the different conditions under which cotton is grown, and to make a preliminary survey of the insect pests likely to be encountered.

In his opinion the discovery of the pink boll worm (*Platyedra gossypiella* Saunders) on the coastal areas will necessitate quarantine measures being enforced to prevent the movement of seed cotton from one state to another, except under guarantee that it has been effectively treated to destroy all long-cycle boll worm larvæ. Measures will also have to be taken for the separate ginning of seed from the coastal areas, and the segregation of lint and seed cotton from those areas where the boll worm has not yet been reported.

Much damage to cotton bolls has been caused this season (1923–24) by the peach moth (*Dichocrocis punctiferalis*) and the cosmopolitan *Chloridea obsoleta* or *Heliothis armigera.* There is a good deal of internal boll rot, due to the invasion of a fungus which effects an entrance into the bolls damaged by boll worms, also possibly through punctures made by such sucking insects as the Harlequin bug. Cotton stainers (*Dysdercus sp.* and *Oxycarœnus sp.*) seem to be comparatively rare, except in one or two areas.

BRISBANE, *June* 26, 1924.

Mr. Ballard has been allotted land on farms in each of the chief cotton-growing parts of Queensland, which he will use for experimental or observation work, and for testing possible methods of control of pests. In the ensuing season it will be necessary to try to arrive at some more or less stop-gap methods of control, so as to afford some relief to the farmer while the thorough and detailed study of various pests is being carried out, a study which is essential before any really satisfactory control measures can be devised.

Some of the regularly recurring pests of cotton can doubtless be largely controlled by improved methods of cultivation, and bad attacks are often simply a matter of indifferent farming. The demonstration of the effects of careless methods of farming is one of the lines to be taken up in the future, and for this purpose a good deal of reliable statistical information will have to be obtained, and the incidence of pests on cotton grown under different methods of spacing will be studied.

With regard to the pink boll worm, the coastal areas near Rockhampton are heavily infested. As one goes farther south, still keeping on the coast, the infestation gets lighter. The farthest south that the pink boll worm has been found *in cotton* is Maryborough, and the farthest west Baralaba, in the Dawson Valley. Its distribution appears to be bound up with that of certain species of Hibiscus and perhaps other Malvaceæ. It has not been found in any other more western cotton areas behind the coastal ranges of hills.

The Callide area, Upper Burnett and Lower Burnett, Lockyer Valley, and south-eastern area, near the New South Wales border, are so far free.

All seed for sowing is treated in a Simon's Heater at Whinstanes. Tests are made daily, while the machine is working, of the germination of the seed and the worms killed where present. All other seed is sent to the oil mill. Sacks and bags which had contained seed cotton are heated to a temperature of 130° F. before being returned to the farmer, to ensure that no clean areas will receive bags from an infected area that may contain boll worms lying in the seams or folds, or in any seed cotton left in the bag.

Weekly returns are submitted from each ginnery showing the districts from which pink boll worm is received.

A METHOD OF PROPAGATING VARIETIES OF COTTON FROM VERY SMALL AMOUNTS OF SEED

BY

KALIDAS SAWHNEY, M.Sc.

Cotton Breeder, Department of Agriculture, Iraq, Baghdad.

INTRODUCTORY.

In raising plants from the seed of a single selected boll of cotton, or from the seed of a boll which is the result of a deliberate cross- or self-pollination, it will be realized that the ordinary method of field sowing which requires the planting of four or five seeds per seed-hole involves an unjustified waste of precious seed, especially in view of the fact that in the final thinning of the crop all but one of the plants in each hill have to be removed. The alternative method of planting only one or two seeds to the hill gives invariably a poor stand. An improvement can be effected in the germination by covering the sown seed with sand instead of with ordinary soil. But even the use of sand does not always ensure a good stand of the resulting crop. This is especially the case when a spell of cold weather immediately succeeds the sowing of the crop. This difficulty of getting a good germination is more marked in heavier soils than in light soils. Unfortunately, the soil of a majority of the breeding plots of cotton at the Agricultural Experimental Station, Baghdad, happens to be of a heavy nature. It is a heavy silt soil, rich in lime and difficult to work. In the course of breeding cottons during the past three years in this locality the writer has often had to be contented with only a few plants, when his requirements both for genetic study and the propagation of new strains demanded the raising of as large a number of plants as possible from the strictly limited quantity of seed at his disposal.

During the sowing season of 1923 an experiment was carried out *to determine the possibility of transplanting cotton seedlings with a view to raise the largest possible number of plants in the breeding or propagation of a new type from a limited quantity of seed.*

It is generally considered that cotton plants cannot be transplanted successfully under commercial conditions. But for purely "experimental" purposes, and under very special conditions of culture, the successful transplantation of cotton seedlings is not a difficult matter.

METHOD OF THE EXPERIMENT.

The method adopted in the experiment may be summarized as follows:

A layer of sand about 2 inches in thickness, and resting on a piece of tin measuring 12 by 8 inches imbedded at surface level in a plot of land, was used as a seed bed. In this particular experiment there were four such beds lying side by side on the ground. A shallow groove was prepared in the soil round each bed. In order to keep the sown seed sufficiently moist for germination, water was let in this groove when required.

On April 24, 350 seeds of the variety of cotton called *Webber* 49-3 were sown at 1-inch intervals in these four beds of pure sand. Before sowing the seeds had been kept overnight in water.

After the completion of germination these layers of sand along with the basal plates of tin were removed *en bloc* into sieves made of close-meshed wire gauze, the margins of which had been bent upwards. These sieves were then held over a slowly running stream of water in such a way that the water of the stream could effectively wash away the sand, but could not carry any germinated seedlings with it. After all the seedlings had been washed, they were carefully transferred to a basin of water, which was covered with a piece of black cloth to prevent the sunlight from falling directly on the roots of the young plants.

Two days previous to the washing of the germinated seedlings a small plot of land had been ridged; and, in conformity with our field practice for commercial cotton cultivation, the land was given a pre-sowing irrigation to determine the water line on the ridges in the plot. The washed seedlings were now planted on these ridges in holes of requisite depth made along the previously determined water line. The planting was done by inserting in an upright position the whole of the radicle and half the length of the hypocotyl of each seedling into the seed hole, which was subsequently filled with sand, care being taken to leave uncovered the cotyledons and that part of the hypocotyl immediately below them. The rate of planting was originally two seedlings to the hill, but as the root tips of some of the young plants were broken through careless handling, the rate of planting was increased to three seedlings per hill. In this way a total of 118 hills was transplanted.

A light watering was given immediately after sowing, and another watering a week later. No other irrigation was given until the plants actually required it a month later.

RESULTS OBTAINED.

The data collected in the experiment are given in the subjoined table.

1	2	3	4	5	6	7	8
Date of Sowing.	*Number of Seeds Sown in Sand.*	*Number of Seeds Germinated.*	*Percentage of Germination.*	*Number of Days Taken to Complete Germination.*	*Date of Transplanting the Seedlings.*	*Number of Seedlings Transplanted.*	*Rate of Planting.*
April 24, 1923	350	340	97·1	Six	May 1, 1923	339	Three seedlings per hill.

9	10	11	12	13	14	15	16
Total Number of Hills Sown.	*Number of Hills with Successful Seedlings.*			*Successful Hills as a Percentage of Hills Sown.*	*Total Number of Plants Survived.*	*Survived Plants as a Percentage of the Total Number of Seedlings Sown.*	*Remarks.*
	Two Seedlings per Hill.	*Three Seedlings per Hill.*	*Total.*				
113	67	44	111	98·2	266	78·4	Figures given in columns 10 and 11 are those recorded on June 6, 1923.

This table is largely self-explanatory. We may, however, refer to the fact that the number of seedlings surviving on June 6 when expressed as a percentage of the total number of seedlings originally sown (see column 15 in the table) is not very high. This low percentage of seedlings that survived may be explained by the fact that the root tips of some of the seedlings had been injured during the operation of planting them on the ridges. Given the careful handling which is necessary at the time of washing the seedlings, and also subsequently at the time of planting them on the ridges, it should be possible to obtain results much better than those obtained in the experiment described above.

SUMMARY.

The comparatively small number of seeds produced per boll of cotton is a decided disadvantage so far as breeding from single bolls is concerned.

The ordinary method of sowing cotton is not suitable for growing plants from the seed of a single selected, selfed, or cross-pollinated boll, because it is wasteful. The cotton breeder cannot afford to sow four or five seeds to the hill and then remove a majority of the plants in the event of a good germination being secured.

When only very small amounts of seed are available, a satisfactory stand of cotton seedlings can be obtained by raising a crop in pure sand, washing the germinated seedlings in running water, and finally planting them on ridges in the way described in the foregoing pages.

To obtain really good results great care should be exercised both when washing the seedlings and subsequently when transplanting them into their permanent position. Injury to root tips should be avoided at all costs.

SPINNING TESTS

CEYLON COTTON

1924 CROP.

Description of Sample.	*Total Waste, per Cent.*	*Nominal Counts.*	*Strength at Nominal Counts.*	*Product of Actual Strength × Count.*
Zulu Hybrid	25·7	77's	27·0	2,069
Durango	26·0	,,	27·3	2,112
Watts' Long Staple ..	30·2	,,	26·2	2,007
Extra Uppers (Control) ..	29·3	,,	25·2	1,882
Sea Island	24·2	95's	27·8	2,705
Zaga 310 (Control) ..	21·5	,,	30·8	2,773 (Ideal=2,500)

Note by the Chief of the Spinning Section in the Experimental Department of the Fine Cotton Spinners' Association.

" On being opened these samples were pulled and commented on as follows:

Durango	$1\frac{3}{16}$ inches	medium fine;	fairly strong.
Zulu Hybrid	$1\frac{3}{16}$,,	fine;	strong.
Watts' Long Staple	$1\frac{5}{16}$,,	,,	fairly strong.
Sea Island	$1\frac{5}{8}$,,	,,	strong.

" They were considered good specimens, clean in handling and easy to work. There should be no difficulty in selling at a good price on appearance in bulk, the first two as Oldham qualities, the two latter for Bolton spinnings.

" It should be remembered that the Card waste is disproportionately high with small samples such as these, representing only a quarter of the normal stripping periods, and would drop considerably in normal working."

The three cottons—Zulu Hybrid, Durango, and Watts' Long Staple—gave satisfactory results when spun to 80's in comparison with Extra Uppers, the yarn strength of all three being slightly better, while the waste of Durango and Zulu Hybrid was considerably less.

The Sea Island was considered to be equivalent to an Extra Sakel, not fine enough to spin Sea Island counts. It was tested against the Super Sakel No. 310, and gave practically the same yarn strength, although it made more waste.

COTTON GROWING STATISTICS—IV.

COMPILED BY

JOHN A. TODD.

As promised in the April issue, a table is now given of the history of the Egyptian crop with some further details supplementing those included in Table I. of the World's Cotton Crops in the issue of January, 1924.

Table V. (*a*) gives the history of the Egyptian crop since 1899, including total area and crop, average yield per feddan, season's average price, and premium over the price of American. The last point is of particular interest in view of the enormous range of the premium, which in recent seasons has averaged as high as 154 per cent. and as low as 16 per cent.

During the last five years two elements of confusion have entered into the Egyptian statistics:

(1) During the season 1920–21, owing to the slump in cotton prices, an enormous quantity of cotton, estimated at one million kantars, was retained up-country, thus reducing the " Arrivals at Alexandria " to a figure far below the real amount of the year's crop. A year later this amount was estimated to be reduced to one-half, thus again confusing the figures for 1921-22, but by the end of the following season it was reduced to a negligible quantity.

(2) Since 1922 there has been a very regrettable difference of opinion between the Government and the market as to the real figures of acreage planted. In 1921, when the restriction of acreage was enforced, the total area fell to 1,291,878 feddans. In 1922 the restriction of acreage was nominally still in force, and the Government's first estimate of the area was only 1,465,136 feddans. This, however, was not generally accepted, and later on the Government issued a revised figure of 1,800,843 feddans. In 1923 the Government's first estimate was again only 1,460,022 feddans, but this also received no credence, the general opinion being that the area was at least as high as in 1923—viz., 1,800,000 feddans. The Government, however, in their subsequent revision, only raised the figure to 1,588,100 feddans. For 1924 the Government's figure is given as 1,787,848 feddans, and the revised figure of last year is maintained. The market, however, definitely refused to accept the Government's

figure of the total, but accepted the admitted increase of roughly 200,000 feddans, and added this to *their own* estimate of last year's figure, making the total for this year approximately two million feddans. The result is that the market refused to consider seriously the Government's crop estimate for this year of 5,944,000 kantars,* preferring a figure based on their own estimate of the acreage; and the crop is now generally placed at about 7,000,000 kantars. It is to be hoped that the result of this year's crop will make it possible to get rid of this unfortunate discrepancy, which at present threatens to be carried forward from year to year. In the meantime this and the question with regard to the up-country carry-over make the estimates of average yield per acre extremely unreliable.

V. (*b*) *Area by Varieties.*—This table brings out in striking fashion the sweeping changes in the principal varieties. It begins in 1913 when Sakel was rapidly displacing Afifi (as well as all other varieties) in the Delta, while the last columns show how Sakel in its turn has been displaced in the Delta by the new incursion of Zagora (an Upper Egyptian variety) into the Delta. Unfortunately, owing to the doubts as to the accuracy of the Government figures of total acreage, the figures of acreage under particular varieties are also not generally accepted; but the changes of the percentage figures are not likely to be *materially* affected. No separate statistics for Zagora this year are yet available.

V. (*c*) *Area by Provinces.*—The chief interest of this table lies in the relative figures of Upper and Lower Egypt. In recent years it also throws some light on the question of the invasion of the Delta by Upper Egyptian varieties, as shown by the following summary table:

	1921.	1922.	1923.	1924.
Lower Egypt. Total area	1,012	1,378	1,194	1,264
Sakel and others	1,029	1,398	1,206	992
Per cent.	101·7	101·5	101·0	78·5
Upper Egypt. Total area	280	423	394	523
Ashmouni and Zagora	263	403	382	796
Per cent.	93·9	95·3	96·9	152·2

It will be seen that until last year Sakel and the others accounted for slightly more than the total Delta area, but this year Zagora and Ashmouni total far more than the entire area of Upper Egypt.

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* This has since been raised to 6,379,862 kantars, but the Alexandria General Produce Association's first estimate is 6,970,000 kantars.

TABLE V. (*a*).—EGYPTIAN AREA, CROP, YIELD AND PRICE, 1899–1923.

Season.	*Area (Feddans, 000's).*	*Crop (Kantars, 000's).*	*Average Yield per Feddan (Lbs.).*	*Season's Average Prices.*	
				F.G.F. Brown (Pence per Lb.).	*Premium over American Middling (Per Cent.).*
1899–1900	1,153	6,510	5·64	6·81	40
1900–01	1,230	5,435	4·42	6·87	33
1901–02	1,250	6,370	5·10	6·31	31
1902–03	1,276	5,839	4·58	8·44	55
1903–04	1,333	6,509	4·88	8·56	23
1904–05	1,437	6,313	4·39	7·37	52
1905–06	1,567	5,960	3·80	9·25	55
1906–07	1,506	6,949	4·61	10·37	63
1907–08	1,603	7,235	4·51	8·81	43
1908–09	1,640	6,751	4·12	8·44	53
1909–10	1,597	5,001	3·13	13·12	67
1910–11	1,643	7,574	4·57	10·75	35
1911–12	1,711	7,424	4·34	9·56	57
1912–13	1,722	7,533	4·37	9·79	46
1913–14	1,723	7,684	4·46	9·45	30
1914–15	1,755	6,490	3·70	7·34	40
1915–16	1,186	4,806	4·06	10·42	39
1916–17	1,656	5,111	3·10	21·56	75
				Sakel.	
1917–18	1,677	6,308	3·75	30·97	43
1918–19	1,316	4,821	3·66	27·85	41
1919–20	1,574	5,572	3·54	60·34	139
1920–21	1,828	6,030*	3·30	30·24	154
1921–22	1,292	4,858*	3·76	19·75	74
1922–23	1,801	6,213*	3·45	17·29	16
1923–24	1,588† 1,800‡	6,531	4·11† 3·62‡	21·55	22
1924–25	1,788† 2,000‡	6,880† 7,000‡	3 57† 3·50‡	—	—

* These figures are an attempt to estimate the actual growth of each season. The arrivals are entirely misleading, owing to the large up-country carry-over, which was estimated as follows:

	Actual Arrivals.	*Up-country.*	*Actual Growth.*
1920–21	5,030	1,000	6,030
1921–22	5,358	500	4,358
1922–23	6,713	—	6,213

† Government estimates.

‡ Private estimates.

TABLE V. (*b*).—EGYPTIAN CROP: AREA BY VARIETIES.

	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.
Sakel	247,292	394,403	547,923	1,032,140	1,133,180	952,481	1,146,443	1,270,481	995,479	1,358,162	1,162,036	872,624
Per cent. ..	14·4	22·4	46·2	62·4	67·5	72·5	72·9	69·5	77·0	75·4	73·2	48·8
Ashmouni ..	356,485	353,882	231,639	343,589	361,874	273,936	334,160	283,906	170,514	276,193	287,171	796,362
Per cent. ..	20·7	20·2	19·5	20·7	21·6	20·8	21·3	15·5	13·2	15·3	18·0	44·5
Zagora	—	—	Not separately recorded.			—	—	97,612	92,536	126,541	94,803	—
Per cent. ..	—	—				—	—	5·3	7·2	7·1	5·9	—
Pilion	—	—	„	„	„	—	—	—	319	20	—	49,960
Per cent. ..	—	—				—	—	—	0·02	—	—	2·8
Afifi	623,737	467,350	209,550	141,446	96,675	36,240	35,145	44,068	6,771	8,202	5,599	22,271
Per cent. ..	36·3	26·6	17·6	8·5	5·8	2·7	2·2	2·4	0·5	0·5	0·4	1·3
Assili	65,958	134,104	49,545	66,602	38,008	20,736	21,003	30,051	5,839	7,863	7,246	
Per cent. ..	3·8	7·7	4·2	4·0	2·3	1·6	1·3	1·6	0·45	0·4	0·5	
Abassi	37,383	12,281	7·468	3,391	3,489	4.871	3,718	12,558	1,267	2,274	1,772	46,626
Per cent. ..	2·2	0·7	0·6	0·2	0·2	0·4	0·2	0·7	0·1	0·2	0·1	2·6
Jannovitch ..	173,439	127,531	28,908	4,220	1,592	223	97	2,087	300	225	4,082	
Per cent. ..	10·1	7·3	2·5	0·3	0·1	0·02	—	0·1	0·02	0·02	0·3	
Nubari ..	201,137	261,775	106,634	62,127	39,339	21,587	23,611	37,320	8,645	11,090	9,862	
Per cent. ..	11·7	14·9	9·0	3·8	2·3	1·6	1·5	2·0	0·7	0·6	0·6	
Others ..	17,663	3,944	4,337	1,997	3,153	5,498	9,485	49,787	10,208	10,273	15,529	
Per cent. ..	1·0	0·2	0·4	0·1	0·2	0·4	0·6	2·7	0·8	0·5	1·0	
Totals ..	1,723,094	1,755,270	1,186,004	1,655,512	1,677,310	1,315,572	1,573,662	1,827,870	1,291,878	1,800,843	1,588,100	1,787,843

TABLE V. (*c*).—EGYPTIAN CROP: AREA BY PROVINCES.

Province.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.
Behera ..	244,717	253,206	177,732	240,874	245,041	209,767	249,071	252,500	184,233	272,561	255,800	235,599
Garbia ..	423,636	432,674	290,083	414,241	411,434	319,220	394,591	453,763	341,376	461,765	372,900	412,917
Dakahlia ..	257,850	264,599	151,777	238,970	238,479	167,935	222,332	258,384	169,483	238,819	199,200	229,872
Sharkia ..	218,161	223,157	158,868	212,189	207,568	171,838	189,289	220,462	163,606	210,194	200,200	195,762
Menufia ..	124,520	127,220	103,297	118,454	123,078	101,802	105,036	123,687	102,007	127,810	106,200	122,604
Galiubia ..	70,725*	72,387	55,258	65,141	68,189*	53,326	58,984	69,707	51,644	66,946	59,700	67,696
Total Lower Egypt ..	1,339,609	1,373,243	937,015	1,289,869	1,293,789	1,023,888	1,219,303	1,378,503	1,012,349	1,378,095	1,194,000	1,264,450
Giza.. ..	41,692	41,883	23,942	32,739	35,858	27,471	30,179	34,658	24,256	40,208	32,200	46,875
Beni Suef ..	77,406	74,754	50,949	72,892	72,936	56,994	67,996	77,297	56,678	74,949	78,700	86,269
Fayum ..	82,341	79,149	76,755	80,058	82,491	84,075	89,983	88,920	82,113	114,303	91,000	98,293
Minia ..	120,390	115,836	68,300	122,743	126,049	90,505	114,542	143,151	83,903	126,931	121,300	155,194
Assiut ..	52,575	58,599	22,988	50,818	59,010	28,596	45,711	89,970	26,791	57,663	58,400	111,852
Ghirga ..	4,582	6,915	1,444	3,392	4,087	579	1,662	7,239	366	3,213	5,000	13,757
Kena ..	4,144	3,955	1,886	2,293	2,297	2,248	3,292	5,762	3,344	5,181	6,800	8,218
Assuan ..	355	936	2,725	708	793	1,216	994	2,370	2,078	300	700	2,935
Total Upper Egypt ..	383,485	382,027	248,989	365,643	383,521	291,684	354,359	449,367	279,529	422,748	394,100	523,393
Grand total..	1,723,094	1,755,270	1,186,004	1,655,512	1,677,310	1,315,572	1,573,662	1,827,870	1,291,878	1,800,843	1,588,100	1,787,843

* Including Canal and Suez Governorates.

TABLE VI.—EMPIRE COTTON CROPS (DEPARTMENTS OF AGRICULTURE FIGURES) CONVERTED WHERE NECESSARY INTO 400-POUND BALES.

A.—Africa (Excluding Egypt).

Season.	*Sudan.*	*Sierra Leone.*	*Gold Coast.*	*Nigeria.*	*Uganda.*	*Kenya.*	*Nyasaland.*	*Rhodesia.*		*Tanganyika.*	*Union of South Africa.*	*Totals.*
								Northern.	*Southern.*			
1918–19 ..	15,997	—	—	*17,500*	34,000	*100*	2,591	*56*	—	—	1,911	72,155
1919–20 ..	23,160	—	*148*	*16,200*	45,730	*100*	2,026	*35*	—	—	2,737	90,136
1920–21 ..	30,519	—	*48*	30,000	81,000	*500*	*3,834*	*100*	—	*7,500*	2,923	156,424
1921–22 ..	24,074	—	*15*	15,096	*40,000*	417	*5,581*	80	—	7,327	2,740	95,330
1922–23 ..	28,306	—	*790*	16,828	92,821	*1,200*	*5,436*	*102*	—	7,175	6,523	159,181
1923–24 ..	47,652	—	—	25,000	129,200	*1,653*	—	*361*	1,544	11,434	7,000*	—
1924–25 ..	55,286*	—	—	—	—	—	—	3,000*	—	—	—	—

B.—West Indies.

Season.	*St. Lucia.*	*Bahamas.*	*Jamaica.*	*St. Vincent.*	*Barbados.*	*Grenada.*	*Trinidad and Tobago.*	*Leeward Islands.*					*Grand Totals.*
								Antigua.	*St. Kitts, Nevis.*	*Mont-serrat.*	*Virgin Islands.*	*Total.*	
1918–19	7	*40*	*9*	1,734	*286*	766	*4*	723	1,413	1,096	59	3,291	6,137
1919–20	11	*19*	*1*	2,046	252	937	*123*	113	1,384	1,371	71	2,939	6,328
1920–21	14	—	*1*	564	221	822	—	285	1,938	988	—	3,211	4,833
1921–22	6	*30*	*7*	754	436	638	—	*77*	875	919	124	1,995	3,866
1922–23	8	*6*	*1*	*1,439*	1,080	826	4	164	1,063	1,160	19	2,406	5,770
1923–24	—	—	—	—	—	—	—	—	1,563	*1,208*	—	—	—

C.—Smaller Empire Crops.

Season.	*Australia.*	*Cyprus.*	*Malta.*	*Mesopotamia.*	*Fiji.*	*Totals.*
1918–19	31	*1,000*	151	—	—	1,182
1919–20	38	3,325	291	—	—	3,654
1920–21	769	2,687	537	60	—	4,053
1921–22	3,129	2,547	1,137	300	—	7,113
1922–23	9,758	1,505	*1,335*	1,100	83	13,781
1923–24	12,500*	2,233	—	*3,300*	—	—

Note.—Where there are gaps in the statistics of the Departments of Agriculture, the figures in *italics* are taken from other sources such as the B.C.G.A. and International Institute of Agriculture, Rome.

* Estimates.

EMPIRE CROPS: REVISED FIGURES.

In the first issue it was explained that in the case of all the smaller crops the method adopted in arriving at the crop was simply to put together all the known estimates and take the mean of them all as an average. At that time, it was pointed out, our records of the official figures of the various Departments of Agriculture in the Empire Cotton Growing countries, which ought to be the most accurate, were still far from complete, but it was promised that as soon as possible a record of their figures alone would be given for recent years.

That record is still not quite complete, and in some cases gaps have been filled in from other sources, but in the table on page 52, which goes back to 1918-19, these have been distinguished by different type. Possibly their appearance here may lead to their correction and completion, which will be welcomed by the compiler.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. Future Development of Cotton-Growing in India. By B. C. Burt. (Abstr. from *Agric. J. of India*, 1924, **19**, pp. 356-368.) In this paper the author states that efforts are being made in India by the Agricultural Departments and by the Indian Central Cotton Committee to assist the Indian cultivator to produce a cotton which will be freely competed for in the world's markets. The ideal cotton for this purpose is said to be " one with a growing period adapted to local climatic conditions, equal or superior in yield to the present varieties, equal to them in ginning percentage, and with a staple of *at least* ⅞ inch, and preferably over 1 inch." The writer considers that this end may be achieved by the following means:

1. The isolation of the best unit species from the existing mixed crop.
2. The use of an acclimatized exotic often involving irrigation facilities and, for complete success, involving the isolation of pure lines.
3. Hybridization.

In addition to the foregoing, the Indian Central Cotton Committee have given grants for the furtherance of research on cotton problems, legislation has been passed to check adulteration, etc., and the question of the improvement of marketing at all stages is receiving careful consideration.

2. Future of Cotton-Growing in Sind. By T. F. Main. (Abstr. from *Agric. J. of India*, 1924, **19**, pp. 473-484.) An interesting description of the geographical characteristics of Sind and of the chief engineering features of the Lloyd Barrage Irrigation Scheme. Under the present design the Barrage will provide sufficient water to develop about ¾ million acres of cotton, this area being capable of increase later if the demand for Sind cotton becomes sufficiently intense to justify a reconstruction scheme.

The author states that early attempts to introduce a staple cotton into Sind resulted in failure, owing probably to the poor irrigation facilities, and also to the severity of boll worm. Recently, however, more success has been obtained with a selected strain of *desi* (27 W.N.) and Punjab-American (4 F.), the former yielding approximately a bale, and the latter five-sixths of a bale per acre. In both cases the gross return per acre amounted to approximately Rs. 200.

In order to succeed in competition with the existing cottons, a longer staple cotton will have to be prolific, hardy and early maturing, capable of withstanding the hot winds of April and May, able to tolerate " kalar " salts in the soil, and prove resistant to red-leaf blight. To cope with the problem it is proposed to establish two stations equipped with perennial irrigation by pumping, with a botanist in charge who will endeavour to produce a high-grade long-staple cotton suitable to the conditions of the province. From his own experience, the author considers that crossing a cotton such as 4 F. with a promising long-staple exotic variety might probably produce a suitable hybrid.

3. Crop Reporting in India. By Rai Bahadur D. N. Ghosh. (*Agric. J. of India*, vol. xix., part v., 1924, pp. 465-472.) Methods for cotton are referred to on p. 465.

COTTON IN THE EMPIRE (OTHER THAN INDIA).

4. The following Annual Reports have recently been received:

Cyprus ..	Annual Report for the year 1923 (Agricultural Department).
Grenada ..	,, ,, ,, ,, 1923 ,, ,,
Kenya ..	,, ,, ,, ,, 1922.
Nyasaland	,, ,, ,, ,, 1923.
Swaziland	,, ,, ,, ,, 1923.
Uganda ..	,, ,, ,, ,, 1923.
Sudan ..	,, ,, of Scientific Research Committee, 1923.

5. ASIA: Cyprus. From the "Annual Report of the Department of Agriculture, Cyprus," for the year 1923, we quote the following:

"As there has been a considerable interest shown recently in the growing of cotton in Cyprus, the following particulars may prove of interest:

"There are in the island no less than 50,000 acres which could be made available for wet and dry cotton-growing, thus permitting a very considerable increase on the present production. The average crop per acre may be set at approximately 100 pounds for dry cotton and 540 pounds for wet. The land could be purchased for, say, £18 and £40 per acre respectively, and rented at £3 and £10 per annum. Cost of production is, for dry cotton, 4d. per pound, and of lint (wet) 2d. per pound; wages, average for men 2s., and women 1s. per diem; transport would run to about 1s. 2d. per cwt. from the cotton fields to the nearest port. The cotton boll worm and fumagine are both found in the island, but the damage done is not considerable. There are no less than twenty-six ginning factories working locally. The export duty on cotton is 8 per cent."

6. Iraq. Advices from Iraq state that the weather conditions on the whole have been favourable to this season's crop, and, notwithstanding damage caused by boll worm, the general indications were that the yield would be above the average for last year.

The Arab cultivators had made rapid advances in their methods of cultivation, and this year showed all-round improvement over previous years, quite a number of the more progressive cultivators having succeeded in raising what promised to be first-class crops.

7. AFRICA: Africa, East. A new journal, *East Africa*, is being published by Messrs. John Bale, Sons and Danielsson, Ltd., 83-91, Great Titchfield Street, London, W. 1. The first number appeared on September 25, and the cost of a single number is 6d., the annual subscription 30s. post free.

In view of the very remarkable expansion in industry, trade, and civilization that is now going on in East Africa, with the great extension of transport facilities, the appearance of this journal is to be warmly welcomed, and we may confidently look to it to aid in the progress that is sure to go on. Much attention is being given to cotton.

8. Kenya. During the year 1923 cotton-growing was chiefly encouraged in the Northern and Central Kavirondo. Four ginneries were established, two were in process of erection, and one was projected; one ginnery was also projected for Southern Kavirondo. Some 6,000 acres of cotton were estimated to mature from the 1923 sowings.

A cotton tax of six shilling-cents per pound of lint was imposed on all cotton produced in 1923.

9. Nyasaland. The report for the year 1923 states that the agreement made with the British Cotton Growing Association to fix in advance the prices at which they would purchase native-grown cotton, had commended itself to the native population, and the amount of seed cotton purchased from native growers in 1923 had nearly doubled that purchased in 1922. There had also been a gratifying demand for seed for the new crop.

Mention is also made in the report of the great and lasting benefit the cotton industry in Nyasaland will derive from the services of the two cotton specialists and the entomologist and agriculturist sent out by the Empire Cotton Growing Corporation.

10. RHODESIA. *Cotton in Southern Rhodesia.* (Abstr. from *South Afr. Cott. Growers' J.*, September, 1924, p. 23.) In this article it is stated that cotton has been grown in Southern Rhodesia at an altitude of 4,700 feet, the yield being 1,800 pounds of seed cotton per acre, and that there are many cases where yields of well over 1,000 pounds of seed cotton per acre have been obtained at altitudes of over 4,000 feet.

Cotton in Southern Rhodesia appears to thrive best on light sandy loams on which tobacco has been grown the previous year. Fertilizers are much used, and the resultant larger yield per acre amply repays the money expended.

This season the rainfall has been exceptionally light—*i.e.*, only 10 to 14 inches —and fears are entertained that with a normal rainfall of 35 inches neither yield nor quality will be as good, but the writer of the article maintains that, given a normal rainfall of 35 inches, evenly distributed over the growing period, and without any violent storms of, for instance, 10 inches of rain a day, cotton growers need not be unnecessarily alarmed. He states that the rainfall records kept in Southern Rhodesia show that the rains have usually ceased when most damage can be caused to cotton—*i.e.*, when the bolls begin to open, and during the picking season.

It is not anticipated that there will be much danger from frosts, the writer maintaining that frost at the end of the picking season is all to the good, as it kills the pests, and in many cases the plants, thus preventing the dangerous practice of ratooning.

With regard to the ginning of the crop, thanks are due to Major Cooper, D.S.O., for assisting the industry by erecting a ginnery at Salisbury, and also for the excellent way in which the ginning of the cotton is carried out there.

The cotton season in Rhodesia as a whole has been satisfactory, and many farmers, who previously had only one or two acres under cotton, intend planting a hundred or more acres this coming season. With regard to ginning facilities to cope with the increased acreage, it is understood that Major Cooper intends putting up a ginnery at Umtali and another at Gwelo, while apart from these, other ginneries will probably be erected at Bulawayo, Gatooma, Shamva, and other places.

The profits on cotton have been excellent, ranging from £5 to £20 an acre, and this fact accounts for the enthusiasm in the country.

11. *Cotton.* (Abstr. from *Rhod. Agric. J.*, vol. xxi., No. 3, 1924, p. 244.) On all sides there is evidence of an enhanced interest in cotton-growing, and, indeed, all the indications seem to point to a Rhodesian cotton boom. At present prices cotton is a very profitable crop in Rhodesia, where the worst cotton pests do not exist, where over large areas the climatic conditions are ideal, and where there is usually plenty of cheap labour of the type required for picking. Many experiments were made in the season just ended, and were almost universally successful; but a word of warning is necessary. The season has been a good one for cotton, and crops have been raised on land where, in ordinary seasons, they would have failed. Farmers on the high veld would do well not to concentrate on this crop alone. There are large areas of territory where cotton can be grown without danger from frost, and to these considerable attention is being devoted. If the hopes of the enthusiasts are realized, cotton promises to be one of the most important of the agricultural products of the colony.

12. SOUTH AFRICA. Great interest has been aroused in South Africa in the prospects of cotton cultivation, and much enthusiasm is being shown in taking it up, so that it would seem probable that before very long that country will be a very important source of the raw material. Under these circumstances a local journal, to focus interest, to keep planters informed of one another's doings, and to distribute information collected from other countries, is much to be desired. We welcome the publication of the *South African Cotton Growers' Journal* (Durban, Central News Agency, 10s. per annum), which is starting to do these things, and which will prove indispensable to all those interested, whether in the cultivation in South Africa or in its markets. Among the articles in the first three numbers may be mentioned the following:

The Cotton Plantation and its Insects, by C. B. Hardenberg, M.A. The African Buyers' Association. Cotton Growing in South Africa. Cotton in Southern Rhodesia. Who's Who in the South African Cotton World. The Central Co-operative Cotton Exchange. Cotton Growing in Griqualand West. Seed Selection. Cotton Culture, etc.

13. *Helping our Cotton Industry.* The following extracts from the *J. Dept. of Agric.*, vol. ix., No. 3, 1924, are indicative of the efforts that are being put forward in South Africa to assist cotton production:

The Government of South Africa are fully alive to the importance of the cotton-growing industry, and are giving it every encouragement and assistance where possible. The Agricultural Department is also endeavouring to promote interest in cotton cultivation by the provision of technical and practical advice, seed distribution, a cotton levy, itinerant instruction, grading, and so forth. Varietal, fertilizer, and breeding tests are being carried out at Rustenburg, with a view to producing heavy-fruiting, long-staple strains; this station also controls itinerant instruction to farmers and the production of pure seed.

In addition to the foregoing, the Tobacco and Cotton Division has two officers employed on grading cotton on behalf of growers. Several university students are undergoing training for the purpose of qualifying for itinerant instruction, which will later on also be given by officers from the Schools of Agriculture and district agents, when appointed. An apprenticeship scheme is also in operation whereby sons of poor farmers can receive free instruction and training in cotton farming at the Rustenburg Station.

Co-operative farming by cotton growers is assisted by a cotton exchange. The Empire Cotton Growing Corporation is, at its own expense, and with the consent of the Government, supplying various technical officers to assist in the investigation of cotton breeding, and the carrying out of experiments on private farms. Finally, Professor Webber, of California University, a recognised authority on cotton cultivation, has been invited by Government to give advice on cotton matters.

14. It is stated in the *Australian Cotton Grower*, vol. ii., No. 6, 1924, that in South Africa adult natives are paid 30s. to £3 per month; youths, 10s. to £1; and women, 15s. to 30s., plus food—generally maize meal. The average cost of cultivating an acre of cotton land is £4, which, on the average crop of 600 pounds of seed cotton, works out at 4·8d. per pound of lint.

15. *Cotton Cultivation in South Africa.* By W. B. Wilson. (Abstracted in *Journ. Text. Inst.*, vol. xv., No. 9, 1924, A. 210.)

16. *Swaziland.* From the Annual Report for Swaziland for the year 1923 recently received, we quote the following:

"The cotton crop has greatly increased. The principal varieties grown are 'Griffin,' 'Watts' Long Staple,' 'Improved Bancroft,' and 'Zululand Hybrid.' The main crop is 'Griffin,' which, with proper selection and acclimatization, is giving excellent results.

"The following is the record of the Swaziland cotton crop for the year 1923:

"Of the total crop, 71 per cent. was graded 'Fully Good Middling'; 87 per cent. was 1⅛ inches or over, whilst 69 per cent. was sold in Durban at 16d. per pound and over."

17. SUDAN. *Cotton Cultivation in the Sudan.* By R. W. Allen. (*Journ. Text. Inst.*, vol. xv., No. 8, 1924, A. 178.) An account of the engineering features of the Gezira irrigation scheme. During the next few years it will be possible to bring under cultivation nearly half a million acres in the Blue Nile and Kassala areas.

18. UGANDA. The third official cotton report for the 1924–25 season states that satisfactory reports have been received from all areas, and weather conditions have been favourable both to the earlier sowings and for the germination of later sowings. Planting continued in most parts of the country, and the total acreage is well in excess of that of any previous year.

19. WEST INDIES. *Handbook of the Leeward Islands.* By F. H. Watkins, I.S.O. (West India Committee, London). A very interesting history of the islands. Cotton is dealt with upon pp. 217-223.

20. *St. Vincent.* (*From the Report on the Agricultural Department,* 1922.) "Manurial experiments were carried out during the year under review with maize. There were seven series and in each there were two plots. The size of each plot was 240 square feet, plants were spaced in the plots 4 feet by 1 foot, and were subsequently thinned out to one to each hole. Manures were applied on October 10, seeds were sown on October 11, and the plots reaped on January 1."

The results are put forward in the following table:

Plot.	*Manure.*	*Calculated Yield per Acre.*		*Gain or Loss on "No Manure" Plots.*
		Green Corn (Pounds).	*Mean (Pounds.)*	
1a 1b	No manure	2,269 3,538	2,903	—
2a 2b	Nitrogen, 30 pounds per acre as sulphate of ammonia	3,449 2,664	3,056	+153
3a 3b	Potash, 30 pounds per acre as sulphate of potash	2,449 2,818	2,633	-270
4a 4b	Nitrogen, 30 pounds per acre as sulphate of ammonia; potash, 30 pounds per acre as sulphate of potash	2,754 3,448	3,101	+198
5a 5b	*Cotton-seed* meal, 1,000 pounds per acre	3,721 2,449	3,085	+182
6a 6b	Potash, 30 pounds per acre as sulphate of potash; cotton-seed meal, 1,000 pounds per acre	2,664 2,541	2,602	-301
7a 7b	Pen manure, 20 tons per acre.. ..	2,845 2,631	2,738	-165

From the above we see that potash, either when applied by itself or when applied in conjunction with cotton-seed meal, had a depressing effect on subsequent yields. When it was combined with nitrate of soda, the plots on which the combination was applied gave an increase of 198 pounds per acre over that reaped from the "no manure" plots. Nitrogen applied as sulphate of ammonia resulted in an increase of 153 pounds on that obtained from the unmanured plots. The results as reaped from the plots receiving organics—*i.e.*, cotton-seed meal and pen manure—varied. In the first instance an increase of 182 pounds over that yielded by the manure plot was obtained, and in the second a decrease of 165 pounds was recorded. A possible explanation of this is that the manurial constituents of cotton-seed meal probably became available to the plants more quickly than did those contained in the pen manure. It would seem, however, as though the results obtained in this series of experiments are in no way definite.

The outstanding fact indicated is the necessity for organic matter in the cotton soils of St. Vincent. It might be stated that in an experiment conducted at the Experiment Station by the Cotton Research Officer, returns of more than 3,000 pounds of seed cotton to the acre were obtained from land which had received only a green dressing.

Spacing experiments are described on p. 15.

The plots which gave the highest returns were those in which the plants were spaced according to the method usually adopted in St. Vincent—*i.e.*, 4 by 2 feet—and this was brought about chiefly by the heavier weight of the bolls produced. It will be seen that the actual number of bolls produced by the plots in Series C was somewhat greater than those of Series A, but the increase was not such as to require any lengthy comment. No increases were obtained from the plots in which continuous planting took place. It may be explained that the term "continuous planting" means that the seeds were sown thickly in drills. It will be readily understood that such a method not only entails more labour, but much more seed is used when establishing the crop.

Cotton selection work is described on pp. 18-20; work with insect and fungus pests (especially cotton stainer), and their control, on pp. 20-25.

The area under cotton is given as 4,745 acres, of which 3,562 were under Sea Island; 1,487 small growers cultivated 2,003 acres, and 32 large growers 2,742 acres. The average yield of lint per acre for the last eleven years has been 96, 98, 106, 76, 78, 66, 95, 95·4, 93, 95, 93 pounds or 90·1 pounds for the total.

Other figures of interest are also given.

21. *Cotton Growing in British Guiana: A Historical Survey.* (*The Daily Argosy*, Georgetown, British Guiana, September 18, 1924, p. 5.)

22. AUSTRALIA. *Cotton Cultivation in New South Wales.* By M. J. E. Squire. (Abstr. in *Journ. Text. Inst.*, vol. xv., No. 6, June, 1924, A. 122.)

23. QUEENSLAND. (*Queensl. Agric. Journ.*, vol. xxii., part 2, 1924, p. 64.) The cotton industry in Queensland continues to advance despite the dry weather and numerous insect pests, although, owing to these causes, the yield per acre in many districts was not as good as might be wished. The total yield is expected to reach 10,000 bales. With a view to controlling the outbreak of pink boll worm, special precautions have been taken in the field and also to insure effective treatment of seed prior to planting. The necessary apparatus has been installed for this purpose, and the Commonwealth Government have also imposed most rigid conditions regarding the importation of cotton seed.

Durango cotton, which produces a good crop and has proved to be of high value for spinning purposes, has been planted wherever possible, and for this season's

48. Treatment of Cotton Seed with Various Pastes. By M. J. E. Squire. (*Agric. Gaz. of N. S. Wales*, **35**, Part 5, 1924, p. 318.) An account of experiments carried out to test the germination of cotton seed, treated with superphosphate and gypsum pastes, agricultural lime, and sulphuric acid, for the purpose of getting rid of the "fuzz," which prevents it from running freely through the plate in the maize drill. The results of the germination tests in the soil were as follows:

Treated with gypsum paste	94 per cent.
„ „ sulphuric acid	93 „
Untreated	88 „
Treated with agricultural lime	84 „
„ „ superphosphate paste	62 „

The seed treated with gypsum paste, sulphuric acid, and the untreated seed came up a day before the lots treated with lime and with superphosphate, which, on coming up, had a difficulty in shedding the old seed-coat. A number of the young plants from the seed treated with lime paste died off shortly after coming up.

49. Cotton Seed Supply. By G. N. Stroman and D. F. Killough. (*Journ. Amer. Soc. Agron.*, 1924, **16**, pp. 127-130. Extracted from *Summ. Curr. Lit.*, vol. iv., No. 7, 1924, E. 15.) Details of the Texas Experiment Station plan for preserving the purity of varieties of cotton developed at the station and distributed to growers are given. Distribution of pure strain seed to individual growers was found to be unsatisfactory because of the lack of understanding of the farmers of proper methods of keeping the seed pure, as well as effective means of increasing and distributing the seed commercially. The present plan involves the formation of local organizations of farmers who agree to grow only one variety of cotton under the terms of a contract formulated by the Texas Station. The success of the plan depends largely upon the leader of the association, who is responsible for maintaining the purity of the seed, and for the sale of the seed raised by the association.

50. Establishing and Maintaining a Desirable Staple in Cotton. By R. R. Childs. (*Ga. Agric. Coll. Bull.*, 288 [1923], pp. 12. Extracted from the *Exp. Stat. Rec.*, vol. l., No. 6, 1924, p. 535.) Variety tests by the Georgia College of Agriculture (E.S.R. **44**, p. 635; **47**, p. 632; **48**, p. 530) showed conclusively that, where the average of several years is considered, early small boll cottons with inferior staple do not produce as much lint per acre. The acre value is also less than can be obtained from well-selected seed of the medium-early large boll varieties such as College No. 1 and Cleveland, which usually possess desirable staples.

51. Single-Stalk Cotton Culture. By O. F. Cook. (*U.S. Dept. of Agric.* Obtainable from Government Printing Office, Washington, D.C. Price 5 cents.)

52. Cotton Fertilization. (*Australian Cotton Grower*, vol. ii., No. 6, 1924, p. 38.) An abstract of the methods in use in the United States.

53. Fertilizers in the Cotton Belt: Forcing an Early Crop. By J. Barry Hutchins. (*Manch. Guard. Comml.*, Amer. Cotton number, August 21, 1924, p. 29.)

54. Fertilizers and Crop Rotations. By J. du P. Oosthuizen, M.Sc. (*Journ. Dept. Agric. S. Africa*, vol. viii., No. 1, 1924, p. 57.) An instructive account of a series of fertilizer and crop rotation experiments commenced in 1909 by the Tobacco and Cotton Division of South Africa. The crop rotation used was as follows: First year, tobacco; second year, cotton; third year, a legume; fourth year, mealies. The soil on which the experiments were conducted was acid, sandy, and contained practically no lime.

The results of the experiments indicate that kraal manure, whenever obtainable, is one of the best manures to use for cotton, and when the soil is acid an addition of lime will further increase the yield. Smaller quantities of kraal manure may be used provided an additional application of from 100 to 200 pounds of superphosphates per acre is given. When a legume is ploughed under, the only other plant-food necessary is an application of phosphates at the rate of about 150 pounds per acre. A yield of 1,130 pounds of seed cotton per acre was obtained from a three-acre field at the experiment station on a type of soil similar to that mentioned above. In this case a legume was ploughed under, and 150 pounds of superphosphates applied per acre.

The gross profits obtained from the different plots were as follows:

Unlimed checks	a profit of approximately	£5	per acre.
Limed	„ „ „	£15	„
Superphosphates and lime	„ „ „	£26	„
A complete cotton fertilizer (consisting of approximately 3 per cent. nitrogen, 10 per cent. phosphoric oxide, 4 per cent. potash), and lime	„ „ „	£29	„
Kraal manure and lime	„ „ „	£35	„

The article contains several illustrations, and there is also a table giving the results of the fertilizer experiments of the years 1910-11 and 1922-23.

55. EXPERIMENTS WITH FERTILIZERS. (*S. Carolina Sta. Rept.*, 1923, pp. 38-45.) Abstr. in *Expt. Sta. Rec.*, vol. l., No. 7, 1924, p. 621.

56. Valuable references and abstracts dealing with soils and manures are to be found in the *Expt. Sta. Rec.* of the U.S. Department of Agriculture, under the head of "Soils—Fertilizers."

57. THE EFFECTS OF BORAX ON THE GROWTH AND YIELD OF CROPS. By J. J. Skinner, B. E. Brown, and F. R. Reid. (*U.S. Dept. Agric. Bull.*, 1126 [1923], p. 31, pls. 11. Extracted from the *Expt. Sta. Rec.*, vol. xlix., No. 4, 1923, p. 325.) "The effect of borax on cotton in experiments conducted at Arlington, Va., and Muscle Shoals, Ala., was to injure severely the plants with 20 pounds of borax per acre, and to injure slightly the plants with 10 pounds per acre. With high rainfall the degree of injury was slight, and with low rainfall the injury was more severe."

58. BORAX INJURY. (Extracted from *Work and Expend. of Agric. Exp. Stations*, 1921, p. 37. Issued by the U.S. Department of Agriculture, 1923.) Tests with borax at the North Carolina station showed that as little as 1 pound of anhydrous borax per acre injured tobacco, and no cotton would grow in pots of sandy soils containing it at the rate of 5 pounds per acre. In clay soils both corn and cotton showed marked injury when the amount of borax exceeded 7 pounds of anhydrous borax per acre, but the plants survived.

59. BORAX INJURY. (Extracted from *Work and Expend. of Agric. Exp. Sta.*, 1921, p. 37. Issued by the U.S. Department of Agriculture, March, 1923.) The proportions of borax in the first case (experiments conducted at Arlington, Va., and Muscle Shoals, Alabama) differ markedly from those in the second (experiments conducted at the North Carolina station), but in each case the effect was injurious, and was worse the greater the amount of borax.

60. THE "PYTHON" COTTON PICKER. Invented by W. J. Thompson, of Durban, South Africa. (See *Manch. Guard., Comml.*, October 16, 1924, p. 448.)

61. MACHINERY IN THE BELT: MODERNIZATION OF COTTON FARMING IMPLEMENTS. By G. Bell. (*Manch. Guard., Comml.*, Annual Review of American Cotton August, 1924, p. 46.)

62. COTTON-PICKING BY SUCTION. (See *The Cotton Farmer*, Queensland, May, 1924, p. 16.)

63. COTTON FIBRE LENGTH V. STAPLING LENGTH. By H. B. Gordon (*Text. World*, 64 [1923], No. 15. Abstr. in *Expt. Sta. Rec.*, 51, No. 3, 1924, p. 235.)

64. COTTON GINS AND GINNERIES. By Lieut.-Col. B. Palin Dobson (127 pp., Tillotsons, Ltd., Bolton). Abstr. in *Journ. Text. Inst.*, vol. xv., No. 7, 1924, p. 280, the last two paragraphs of the abstract being quoted below:

"The book is unique in encouraging a start to be made in cotton-growing, by showing how the farmer can use a manually-operated gin in his tentative steps of growing cotton, and as he finds success attending his efforts the book opens out a wide variety of comprehensive schemes for dealing with large quantities of cotton, for delinting the seeds already ginned, for baling, and, in general, for a practically automatic process where labour and skill are reduced to a minimum.

"For propaganda purposes the book can be strongly recommended to the British Cotton Growing Association as a valuable auxiliary to their present methods of publicity among the agriculturists of the Empire within the cotton-growing belt."

(*Cf.* also Abstracts 65, 110, 125, 131, 132.—ED.)

DISEASES, PESTS, AND INJURIES, AND THEIR TREATMENT.

65. CLEAN CULTIVATION AGAINST COTTON PESTS. (*The Australian Cotton Grower*, vol. ii., No. 6, 1924, p. 23.)

66. COTTON DISEASES IN SOUTH AFRICA. By E. M. Doidge. (Abstr. in *Journ. Text. Inst.*, vol. xv., No. 6, June, 1924, A. 143.)

67. COTTON PESTS. AUSTRALIA. METHODS OF CONTROL. By J. D. Young. (*The Australian Cotton Grower*, vol. i., No. 12, 1924, pp. 24-25.)

68. DISEASES OF CROP PLANTS IN THE LESSER ANTILLES. By William Nowell, D.I.C., Assistant Director of Agriculture, Trinidad and Tobago. Specially reviewed by C. A. Barber, C.I.E., Sc.D., F.L.S. (See *West India Committee Circular*, vol. xxxviii., 1923, p. 457.)

69. DISEASES OF THE COTTON PLANT—I. By W. A. Birmingham and I. G. Hamilton. (*Agricultural Gazette, New South Wales*, November, 1923, p. 805.) The first portion of a brief illustrated account of the chief diseases of cotton.

70. A MULTIPLE TEMPERATURE INCUBATOR. By C. B. Williams and T. W. Kirkpatrick (Gov. Publ. Office, Min. of Finance, Dawawin P.O., Cairo. Price, P.T. 3).

71. COTTON BOLL WEEVIL. (*Work and Expend. of the Agric. Exp. Stations*, 1921, p. 73. Issued by U.S. Dept. of Agr., 1923.) In hibernation studies at the South Carolina station, of 1,000 weevils placed in cases 12 per cent. hibernated successfully and came out alive in the spring, the majority coming out during April, and all were out by June 1. The Georgia station reports that dusting with calcium arsenate just about paid for the cost of treatment.

The Alabama station has studied weather conditions as affecting weevil injury. If sufficiently hot and dry for a period of more than a month, especially during the first part of the fruiting season, the weevils may be naturally controlled so fully that dusting will not be needed or will not pay. While it may appear to be inadvisable to dust in periods of frequent rains, it is believed that every effort should be made to continue dusting at the usual four or five day intervals, in spite of threatening weather, as there is no natural control at such times, and the weevils multiply with great rapidity. As the margin of profit per acre decreases there must be a prospect of higher yield to justify dusting. In tests made at the station the profit from dusting in most cases increased rapidly as the margin of yield increased above half a bale per acre.

The Texas station reports an increase of fully 30 per cent. of the cotton crop when lead arsenate was properly applied for the control of the boll weevil. At the Mississippi station parasites of this insect were found to vary much in different localities from none to 50 per cent. Calcium arsenate, both as dust and spray, as well as mixed with molasses and applied by hand, when properly applied, controlled the weevils to such an extent that paying results were obtained when cotton was grown on land fertile enough to make a half-bale or more to the acre without weevil damage. It was found that the pink boll worm is readily killed at a temperature of 125° to 130° F., and cotton seed will stand temperatures of 175° to 180° F. for several hours.

72. Boll Weevil Cotton in Texas. By O. F. Cook. (*U.S. Dept. Agr Bull.*, No. 1153, 1923, 20 pp., 4 plates. Abstr. from *Expt. Sta. Rec.*, 1923 vol. xlix., No. 5, p. 432.) The author describes the effect on cotton plants of boll weevil infestation early in the season, and suggests the measures that should be taken, by closer spacing, etc., to combat the destruction caused by the pest. A list of publications on weevil resistance and close spacing of cotton is appended.

73. Suggestions Relative to the Boll Weevil. By C. E. Sanborn. (*Oklahoma Sta. Circ.* 53, 1923, pp. 3-16, figs. 11. Extracted from *Expt. Sta. Rec.*, vol. xlix., No. 6, 1923, p. 558.) This is a brief summary of information on the boll weevil, and measures for preventing its injury.

74. Dusting for the Cotton Boll Weevil. By B. R. Coad and T. P. Cassidy. (*U.S. Dept. Agr. Dept. Circular* 274, 1923, 3 pp. Extracted from *Expt. Sta. Rec.*, vol. xlix., No. 6, 1923, p. 558.) Points out the conditions under which it will pay to dust for the control of the boll weevil, and describes the dusting machines which should be used and the manner in which the dust should be applied.

75. Cotton Dusting Machinery. By E. Johnson, S. T. Howard, and B. R. Coad. (*U.S. Dept. Agr. Farmers' Bull.* 1319, 1923. Abstr. from *Expt. Sta. Rec.*, vol. xlix., No. 6, 1923, p. 590.) This bulletin supersedes Farmers' Bulletin 1098 (*E.S.R.* 42, p. 786), and presents practical information to the prospective buyer of cotton dusting machinery on how to select a type of dusting machine suited to the conditions and needs of his own farm.

76. Distribution of Arizona Wild Cotton (*Thurberia thespesioides*). By H. C. Hanson. (*Arizona Station Tech. Bull.* 3, 1923, pp. 49-59. Abstr. from *Expt. Sta. Rec.*, vol. xlix., No. 6, 1923, p. 558.) The author reviews and tabulates the literature relating to the distribution of the host plant of the wild cotton boll weevil (*Anthonomus grandis thurberiæ*) in Arizona. A map is given of the southern part of Arizona showing the known distribution of the Arizona wild cotton and the wild cotton boll weevil. It is concluded that intensive scouting in the future will undoubtedly show a wider distribution of Thurberia. Bibliography of fifteen references. (And *cf.* Abstract 91, below.)

77. Boll Weevil Investigations in 1923. (*S. Carolina Sta. Circ.*, 31 [1924], pp. 3-18. Extracted from *Expt. Sta. Rec.*, **50**, No. 7, 1924, p. 663.) This is a report of work conducted in co-operation with the U.S.D.A. Bureau of Entomology in 1923, and in continuation of work previously noted (E.S.R. 46, p. 652). An account is given of poison experiments in cages; field experiments with poisons in the central and eastern part of the State; the details of which are presented in

tabular form; field experiments with poisons in the upper Piedmont; work with new poisons; dusting machinery; weevil hibernation, etc.

The results from this season's work show very clearly that after the plants get large enough to begin blooming freely, the only effective means of reducing weevil infestation is by the use of a dust cloud of calcium arsenate applied with a machine that thoroughly atomizes the dry dust and gives a blast that drives the material down through the cotton plant.

78. METHODS OF BOLL WEEVIL CONTROL. By R. P. Bledsoe. (*Georgia Sta. Circ.*, 78 [1924], pp. 5*a*-12*a*; abstr. in *Expt. Sta. Circ.*, 51, No. 1, 1924, p. 59.)

79. THE BOLL WEEVIL PROBLEM IN ARKANSAS. By D. Isley and W. J. Baerg. (*Ark. Sta. Bull.*, 190 [1924], pp. 3-39; abstr. in *Expt. Sta. Rec.*, vol. l., No. 9 [1924], p. 850.)

80. A PROGRESS REPORT OF BOLL WEEVIL POISONING WORK AT THE HOLLY SPRINGS BRANCH EXPERIMENT STATION. By C. T. Ames. (*Miss. Sta. Circ.*, 51 [1923], pp. 11; abstr. in *Expt. Sta. Rec.*, vol. l., No. 8, 1924, pp. 761-763.)

81. COMBATING THE BOLL WEEVIL. (*Georgia Sta. Rept.*, 1923, pp. 42-43. Abstr. in *Exp. Sta. Rec.*, 51, No. 2, 1924, p. 162.)

82. HABITS AND CONTROL OF THE COTTON BOLL WEEVIL IN NORTH CAROLINA. By R. W. Leiby and J. A. Harris. (*N.C. Dept. Agr. Bull.*, March, 1924; abstr. in *Expt. Sta. Rec.*, 51, No. 3, 1924, p. 258.)

83. FURTHER EXPERIMENTS WITH THE FLORIDA METHOD OF BOLL WEEVIL CONTROL. By G. D. Smith. (*Fla. State Plant Bd. Quart. Bull.*, 8 [1924], No. 2; abstr. in *Expt. Sta. Rec.*, 51, No. 3, 1924, p. 259.)

84. FIGHTING THE BOLL WEEVIL: RENEWED AMERICAN CAMPAIGN. (*Agr. Journ. of India*, vol. xix., part 4, 1924, p. 438.)

85. THE CAMPAIGN AGAINST THE BOLL WEEVIL. METHODS OF CONTROL. By E. M. Miller. (*Manch. Guard. Comml.*, Ann. Rev. of Amer. Cotton, August, 1924, p. 28.)

86. INFLUENCE OF WEATHER ON YIELD. NEW CONDITIONS ESTABLISHED BY THE BOLL WEEVIL. By G. W. Fooshe. (*Manch. Guard. Comml.*, Ann. Rev. of Amer. Cotton, August, 1924, p. 26.)

87. FILLING THE GAP MADE BY THE WEEVIL. SUITABILITY OF OUTSIDE GROWTHS. By J. A. Todd. (*Manch. Guard. Comml.*, Amer. Cotton number, August 21, 1924, p. 47.)

(*Cf.* also Abstract 43.)

88. THE PINK BOLL WORM IN EGYPT IN 1922. By C. B. Williams. (*Third Ann. Rep. Cotton Research Board*, Giza, 1922, pp. 1-7.)

89. CONTROL OF THE PINK BOLL WORM ON COTTON. By E. McKenzie Taylor. (*Nature*, May 24, 1924.)

90. THE PINK BOLL WORM SITUATION. By W. H. Hunter. (*Calif. Dept. Agr. Mo. Bull.*, 12 [1923], No. 6, pp. 287-294.)

91. THE PINK BOLL WORM OF THURBERIA, *Thurberiphaga catalina*. By J. L. Webb. (*Journ. Econ. Ent.*, 16 [1923], No. 6, pp. 544-546. Extracted from *Expt. Sta. Rec.*, vol. l., No. 7, 1924, pp. 660-661.) This is a contribution from the U.S.D.A. Bureau of Entomology. The noctuid *T. catalina*, which was found infesting Thurberia bolls in Arizona in 1913, and has been described by H. G. Dyer as a new genus and species under the name of *T. catalina*,* constitutes a great menace to the cotton grown in the valleys of Arizona below the range of

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* *Insecutor Inscitiæ Menstruus*, 7 (1919), Nos. 10-12, p. 188.

Thurberia. An account is given of the rearing of the adult, with notes on parasites of the larval stage. A list of other Thurberia insects collected is included. (And *cf.* Abstract 76, above.)

92. A PRELIMINARY NOTE ON THE ESTIMATION OF LOSS BY BOLL WORMS. By Ibrahim Bishara. (*Egypt. Min. Agr. Tech. and Sci. Serv. Bull.*, 39 [1924], pp. 22. Extracted from *Expt. Sta. Rec.*, 51, No. 2, 1924, p. 158.) This account, the details of which are presented in chart and tabular form, is based upon investigations of loss in quantity of cotton from the attack of boll worms, conducted in various parts of Egypt during the last five years.

93. COTTON PESTS. THREE DANGEROUS ENEMIES AT WORK. By Sir Arthur E. Shipley, G.B.E., F.R.S. (*Manch. Guard. Comml.*, Ann. Rev. of Amer. Cotton, August, 1924, p. 37.) An excellent account of the boll weevil, boll worm, and pink boll worm, which should be read by all interested.

BOLL WORM. (*Cf.* also Abstracts 5, 6, 94, 98, 108.—ED.)

94. INSECT ATTACK ON STANDOVER COTTON. By E. Ballard. (*Queensl. Agric. Journ.*, vol. xxi., Pt. 5, 1924, p. 406.) A sample of 100 green bolls three-quarters grown was taken recently from a standover crop in the Rockhampton district. These bolls were picked at random. The cotton was growing among the stumps and was not free of weeds.

The following figures are not without interest, and give the results of the examination of the sample:

Number of sound bolls, 27.	
Attacked by maize grub	2
,, ,, peach ,,	15
,, ,, pink boll worm	13
,, ,, boll rot, apparently following on insect punctures	26
,, ,, ,, ,, punctures not seen	4
,, ,, ,, ,, just beginning	3
Unidentified insect attack	10
Total damaged from all causes	73

In every case of boll worm attack from any of the three species concerned, boll rot had set in, destroying 2, 3, or 4 locks. Some allowance must always be made for human error in sampling, but in the case of pink boll worm attack this does not apply, as no trace of attack can be seen until the boll is opened.

95. APHIS ON COTTON. By D. S. Wilkinson. (*Cyprus Agric. Journ.*, vol. xix., part 3, 1924, p. 104.) Instructions for combating this pest by kerosene emulsion spraying.

96 SPRAY GUN v. NOZZLE: THEIR COMPARATIVE EFFICACY AGAINST WOOLLY APHIS. By W. M. Walker. (*Agric. Gaz. of N.S. Wales*, vol. xxxv. part 8, 1924, p. 589.)

97. THE EGYPTIAN COTTON SEED BUG (*Oxycarenus hyalinipennis*, Costa): ITS BIONOMICS, DAMAGE, AND SUGGESTIONS FOR REMEDIAL MEASURES. By T. W. Kirkpatrick. (*Bull.* No. 35, *Tech. and Sci. Service, Min. of Agric., Egypt.* Govt. Publ. Office, Min. of Finance, Dawawin P.O., Cairo. Price, P.T. 10.)

98. DUSKY COTTON BUG (INDIA), DESCRIPTION OF. By C. S. Misra. (*Bot. Abstr.*, 1923, **12**, p. 444; from Rept. Proc. Fourth [Pusa] Entomol. Meeting, 1921, pp. 84-92. Extracted from *Journ. Text. Inst.*, 1923, vol. xiv., No. 12, A. 300.) The dusky cotton bug (*Oxycarenus lœtus*) not only directly lowers the vitality of the seed and injures the lint, but indirectly introduces a host of fungoid and bacterial diseases which conjointly reduce the seed vitality to a minimum. Such damaged seeds are lighter in weight, somewhat discoloured, and do not produce healthy and vigorous plants. The adults and nymphs of this insect move freely about over the plant, and are particularly active in the bolls, where they attack the seeds for their mucilaginous material. The seed coats in such cases show numerous fine perforations, presumably made by the probosces of these bugs. Since this insect does not enter the unopened bolls, its worst injuries follow attacks by the boll worm. Details of life-history are given.

99. COTTON WOOLLY MITE IN INDIA, CONTROL OF. By T. N. Jhaveri (*Bot. Abstr.*, 1923, **12**, p. 443; from Rept. Proc. Fourth [Pusa] Entomol. Meeting, 1921, pp. 96-97. Extracted from *Journ. Text. Inst.* Dec., 1923, vol. xiv., No. 12, A. 300.) The disease for which cotton woolly mite (*Eriophyes gossypii*) is responsible is known in the vernacular as *chhasia* on account of the ash-like appearance of affected leaves. In years of drought it spreads over wide areas, greatly checking the growth of the cotton plant. Affected leaves remain small and curl upward. Checking of the disease in December and January is apparently brought about by the heavy dews of winter. The mites live mostly under the epidermis of the leaf, and cause a dense growth of hairs on both surfaces and on the stem. At an advanced stage of the crop tiny predatory grubs of "Coccinellid" beetles attack the mites and greatly reduce their numbers. Artificial control is also discussed.

100. NOTES ON COTTON STAINER CONTROL. By C. L. Withycombe. (*Trop. Agriculture*, vol. i., No. 10, 1924, p. 156.)

101. COTTON PESTS. In the *Queensl. Agric. Journ.*, vol. xxi., part 1, January, 1924, p. 3, Mr. F. G. Holdaway, B.Sc., gives a brief report on two insects which recently caused considerable damage to cotton seedlings in the Rockhampton district by attacking the foliage. These insects were the *Neocleptria punctifera, Wlk.*, and a cut-worm since recognized as the *Agrotis radians*.

In the February issue of the same journal, on p. 120, Mr. J. L. Froggatt, B.Sc., has compiled some interesting notes on the various moths which attack cotton —*i.e.*, the Cotton Worm (*Chloridea obsoleta*), Spotted Maize Moth (*Dichocrocis punctiferalis*), Rough Boll Worm (*Earias huegli*), *Cosmophila xanthindyna*, and *Bucculatrix*. Mention is also made of various plant-eating beetles and plant bugs which, in some cases, cause serious damage to the cotton plants.

Both the above articles are illustrated.

102. A NEW COTTON PEST. By J. H. Simmonds, B.Sc. (*Queensl. Agric. Journ.*, vol. xxi., March, 1924, pp. 187-191.) A description of a Chrysomelid beetle, the *Rhyparida australis Boh.*, and its habits. This insect has done much damage to the cotton plants in the Woolooga district of Queensland. Measures for control are stated, and the paper is illustrated.

103. THE COTTON PLANTATION AND ITS INSECTS. By C. B. Hardenberg, M.A. An instructive series of articles appearing in the August, September, and October issues (1924) of the *South African Cotton Growers' Journal*.

104. INSECT PESTS OF COTTON. By C. B. Symes. (*Rhodesia Agric. Journ.*, vol. xxi., No. 2, April, 1924, pp. 136-151.)

105. INSECT PESTS OF COTTON IN NEW SOUTH WALES. By W. B. Gurney. (*Australian Cotton Grower*, Sydney, vol. ii., No. 1, 1924, and subsequent numbers.) An illustrated account of the many pests that show themselves upon cotton in the State, with directions for their treatment.

106. RECENT PROGRESS WITH INSECTICIDES. By C. L. Withycombe. (*Trop. Agriculture*, vol. i., No. 8, 1924, p. 114.)

107. JASSID RESISTANT COTTONS. By Lloyd Worrall. (From *Sum. Cur. Lit.*, B.C.I.R.A., vol. iv., No. 6, 1924, E. 13.) Observations show that certain strains of American Upland cottons, owing to the natural hairiness of the plants, were practically immune to injury from the Jassid or leaf hopper, *Chloreta fascialis*. That the hairs protect against the Jassid is indicated by the fact that the hairless varieties were the first to be attacked. Where this pest is prevalent, cotton breeders should include hairiness as one of the characters to be selected. A correlation between hairiness and short staple has been observed, so that care should be exercised to select only hairy plants with good staple.

108. The following Technical and Scientific Service Bulletins have been published by the Ministry of Agriculture, Egypt, and can be obtained from the Government Publications Office, Ministry of Finance, Dawawin P.O., Cairo:

Bulletin No. 19: "A Wound Parasite of Cotton Bolls," by H. R. Briton-Jones.

Bulletin No. 24: "Dispersion of the Pink Boll Worm in Egypt," by Dr. Lewis H. Gough.

109. COTTON-ROOT ROT: CONTROL. By J. J. Taubenhaus and D. F. Killough. (*Rev. Appl. Mycology*, 1924, **3**, 134-136; from *Texas Agric. Exp. Sta. Bull.*, 1923, No. 307, pp. 98. Extracted from *Sum. Cur. Lit.*, vol. iv., No. 7, 1924, E. 14.) A report of the results obtained to date in an investigation of the Texas root rot of cotton. The disease is due to the organism *Phymatotrichum* (*Ozonium*) *omnivorum*, and causes considerable damage both by reducing the quantity and affecting the quality of the lint produced. A wide range of crops, trees, plants, and weeds is susceptible to attack by this organism, and control measures should be directed towards as complete an eradication as possible of the roots of all susceptible hosts. This may be secured by frequent clean cultivation, by ploughing when the soil is dry, and by pulling out all cotton roots after the last picking of the crop, exposing them to drying for a few weeks and then ploughing them under. A system of fallow and rotation with non-susceptible hosts, several types of which are suggested, may also be helpful. Affected plants usually show no premonitory signs of stunting or yellowing; they appear normal and healthy until they suddenly wilt, and die within a day or two.

110. COTTON-ROOT ROT FUNGUS. By C. J. King (*Journ. Agric. Res.*, 1923, **26**, pp. 405-417. Abstr. from *Journ. Text. Inst.*, vol. xv., No. 4, April, 1924, A. 92.) An account of the damage to cotton by root rot (*Ozonium omnivorum*) in the Salt and Gila River Valleys of Arizona. Soaking the soil with formaldehyde stops the spread of the root-rot fungus. Cotton plants in soil thus treated shed their leaves, but afterwards recover and resume growth.

111. EXPERIMENTS IN COTTON-ROOT ROT CONTROL. By C. J. King. (*U.S. Dept. Agric.*, *Dept. Circ.*, 277, 1923, pp. 35-37.)

112. COTTON WILT A SEED-BORNE DISEASE. By J. A. Elliott. (Abstr. in *Phytopathology*, 12, 1922, No. 1, pp. 50-51. Extracted from *Expt. Sta. Rec.*, **50**, No. 8, 1924, p. 748.) From a study of cotton seed delinted with concentrated sulphuric acid and afterwards strongly surface sterilized with corrosive sublimate, the author concludes that cotton wilt due to *Fusarium vasinfectum* is carried by the seed.

113. NOTES ON COTTON WILT IN THE SOUTHERN MARATHA COUNTRY. By G. L. Kottur, M.Ag. (*Agric. Journ. India*, vol. xix., part 2, 1924, p. 155.)

114. A PRELIMINARY ACCOUNT OF THE INVESTIGATION OF COTTON WILT IN CENTRAL PROVINCES AND BERAR. By J. F. Dastur. (*Agric. Journ. India*, vol. xix., part 3, 1924, pp. 251-260.)

115. Effect of Seed Storage on Cotton Anthracnose. By C. A. Ludwig. (*Phytopathology*, 1924, p. 14, 52. Abstr. from *Journ. Text. Inst.*, vol. xv., No. 4, April, 1924, A. 92.) Describes the effect on cotton seed infected with cotton anthracnose of storage under dry and moist conditions.

116. The Control of Angular Leaf Spot of Cotton. By C. A. Ludwig. (*Phytopathology*, 12 [1922], No. 1, pp. 20-22.)

117. Cotton Pest: Description. By N. Patouillard. (From the *Sum. Cur. Lit.*, B.C.I.R.A., vol. iv., No. 6, 1924, E. 13.) A number of plants of the *Gossypium punctatum* species of cotton from Dahomey were found to be seriously injured by a fungus considered by the writer to be a form of *Botryodiplodia theobromæ*. Since this fungus, in its different forms, grows on various plants in tropical regions, it may become a dangerous pest if its attack on cotton tends to spread.

118. Studies of the Bacterial Decay of Textile Fibres. I. Variations in the Resistance of Cottons of Different Origins to Destruction by Micro-organisms. By A. C. Thaysen and H. J. Bunker. (From the *Biochem. Journ.*, vol. xviii., No. 1, 1924. Cambridge.)

119. Bacterial Infection of Cotton Bolls. By E. Ballard and D. Norris. (*Agric. Journ. India*, **18** [1923], No. 1, pp. 40-49. Extracted from *Expt. Sta. Rec.*, **51**, No. 2, 1924, p. 152.) A shedding of bolls from Cambodia cotton (*Gossypium hirsutum*) in 1919-1920, accompanied by a discoloration of the bolls and seeds and often of the lint, which showed also a slimy and rotten appearance, led to a study of the matter in 1921.

The rotting and premature fall of tender cotton bolls appears to be largely because of a bacterial disease which is not due to *Bacterium malvacearum*. Angular leaf spot has not been found in the district under observation. No fungus was found associated with the disease in its early stages. Insects appear to play a prominent part in the dissemination of the disease by affording a ready means of entrance. The two which may be concerned in the spread of the disease are *Ragmus morosus* and *R. flavomaculatus*.

The organism considered responsible grows readily on a variety of culture media, and produces moist whitish translucent colonies on agar cotton-boll extract medium.

120. Cotton Stenosis (Haiti): Description. By O. F. Cook. (*Journ. Heredity*, 1923, **14**, pp. 323-335. Extracted from *Sum. Cur. Lit.*, vol. iii., No. 18, 1923, E. 34.) A new disease of cotton in Haiti is described under the name "smalling," or *stenosis*. The disease, which causes abnormal growth and sterility, is similar to the Chinese cotton diseases known as club-leaf, or *cyrtosis*, but its effects are much more severe. In Haiti it was found to have attacked all the representatives of American upland cotton, Sea Island cotton, Meade Upland, and Sea Island hybrids, and crosses of these types with native Haitian. Haitian cotton itself (Bourbon, *G. purpurascens*, a perennial shrub reaching 10 to 12 feet in height) was apparently immune. The disease belongs to the group of so-called mosaic diseases. The affected plants are usually deficient in chlorophyll, and show different shades of colour with angular spots or areas, some of lighter and some of darker green. After growing normally as seedlings and into the stages of flowering and fruiting, there is an abrupt change to an abnormal habit of growth with the branching irregular, the leaves contracted and distorted, and the floral buds mostly aborting. The article is well illustrated.

121. Mosaic Disease. By Charles E. Simon. (*Physiol. Reviews*, 1923, **3**, p. 487. Extracted from the *Summ. Curr. Lit.*, B.C.I.R.A., vol. iii., No. 16, 1923, A. 46.)

"In a review of the literature on filterable viruses, attention is called to the work of Bauer (1904) on mosaic diseases of the *Malvaceæ*. Bauer found that the diseases could not be transmitted to healthy plants by inoculation of the expressed juice from diseased leaves, but only by grafting, and that only those leaves developed the malady which were in the primordial stage at the time of grafting, or shortly thereafter. The virus must be reproducible, for it is possible to infect an unlimited number of healthy plants with grafts from a single diseased leaf, but the virus cannot be living matter itself, since the expressed juice is innocuous. This evidence is used by the writer of the review in support of the conception of a *contagium inanimatum*."

122. REPORT OF FIELD CROPS WORK IN TEXAS, 1921. (Texas Sta. Rept., 1921. Extracted from the *Expt. Sta. Rec.*, vol. xlix., No. 5, 1923, p. 429.) "Results in a study of spacing and time of thinning of cotton indicate that late thinning is harmful rather than beneficial, and that with adequate moisture supply and cultivation and absolute freedom from competing weeds and grasses, cotton may be left much thicker in the row than usual. Many of the best yields were secured with spacing from 6 to 12 inches apart in 3-feet rows. Observations at Spur showed that hail-damaged cotton plants, with from two to four fruiting branches and with green buds in the axils of the leaves, could be partially saved when cultivated as soon as possible after the hail. Of those plants cultivated immediately after the hail, 22 per cent. survived and produced fruit. All young cotton plants not yet branched died whether cultivated or not. The value of home-grown cotton seed was demonstrated at several points." (*Cf.* Abstr. 208, p. 313, 1924, "Cotton Spacing," by H. B. Brown, and 72 "Boll-Weevil Cotton in Texas.")

123. COTTON MILL FUNGI: IDENTIFICATION. By W. H. Snell. (*Journ. Text. Inst.*, vol. xv., No. 8, 1924, A. 208.) Observations are recorded upon the occurrence of seven species of myxomycetes and fungi in cotton mills.

124. SULPHUR. TOXICITY. By H. C. Young. (*Rev. Ap. Mycology*, 1923, **2**, p. 460; from *Ann. Miss. Bot. Gard.*, 1922, **9**, pp. 403-433. Extracted from the *Sum. Cur. Lit.*, B.C.I.R.A., vol. iii., No. 16, 1923, A. 48.) The question of sulphur sprays has led the author to determine the toxicity of the vapours of flowers of sulphur and of hydrophilic and hydrophobic colloidal sulphur to *Botrytis cinerea*, *Colletotrichum gossypii*, *Sclerotinia cinerea*, etc. The spores were placed in drops of a slightly buffered culture solution without sulphur, the sulphur suspensions being placed at the bottom of Van Tieghem cells. Flowers of sulphur had no toxic action and the hydrophobic colloidal sulphur was only slightly toxic to *B. cinerea* and *C. gossypii*. The hydrophilic colloidal sulphur was extremely toxic, especially at concentrations of pH 4·0 to 5·5.

BREEDING.

125. ORIGIN AND RESULTS FROM HEATON VARIETY OF COTTON (NOW KNOWN AS "H.23-2-13"). (Abstr. from "Rep. of Agric. Dept., Montserrat," 1921-1922.) —In May, 1909, a small sample of cotton seed was received from J. R. Bovell, Esq., I.S.O., the Superintendent of Agriculture at Barbados. No particulars of the origin were at the time supplied with the seed other than that it was to be called the Heaton variety.

Recent correspondence with a firm of fine cotton spinners in England, Messrs. William Heaton and Sons, has, however, disclosed the fact that this seed was collected in their mills when spinning what was regarded as a crop lot of the finest Carolina Sea Island cotton in the year 1909, the seeds being sent through the brokers of the B.C.G.A. to the West Indies.

The Heaton 9 type of cotton was gradually introduced into cultivation on estates by the distribution of seeds from the breeding plot in the experiment station from 1912 onwards, and in the year 1914 it was estimated that the area in this type on estates was in the neighbourhood of 1,000 acres. In the meantime the re-selection of the Heaton 9 type in particular was continued in the experiment station, and after the analysis of all the data in connection with the sub-types cultivated, the seeds of the best strains were in succeeding years bulked to form a seed field, the seed from which was distributed to estates to plant seed fields in the following years.

During the re-selection work of following years, actually in 1915-16, a special plant was discovered with certain factors above the average in value, but particularly in connection with lint index and percentage of lint. The seeds of this plant were grown as H. 9 No. 23 on the breeding plot in 1916-17, and the satisfactory features shown by the parent in 1915 were found to be inherited.

The usual re-selections from this type were grown in progeny rows in the following year, and amongst the types was one, No. 23-2, which showed a result on twenty consecutive plants of lint length 52 mm., seed weight 13·52 grammes, lint index 5·63 grammes, percentage of lint 29·7 per cent.

In the succeeding year, 1918, one of the progeny of the H. 23-2 type grown as No. 13 gave an average result of fifty consecutive plants of lint length 48 mm., seed weight 13·24 grammes, lint index 6·02 grammes, and percentage of lint 31·2 per cent.

On examination of the data in connection with the cultivation of this cotton, the then assistant for cotton research, Dr. S. C. Harland, pointed out that this was a most desirable strain, and the work of 1919, 1920, and 1921 has been chiefly concerned in breeding extractions from this H. 23-2-13 type of cotton.

126. TEXAS COTTON: CORRELATIONS. By H. Dunlavy. (*Journ. Amer. Soc. Agronomy*, 1923, **15**, pp. 444-448. Extracted from *Sum. Cur. Lit.* vol. iii., No. 18, 1923, E. 35.) The methods adopted in the determination of staple, lint per cent. weight of seed, lint index, boll size, number of seeds per lock, and percentage of 5-lock bolls, are described, and correlations between these characters are given. It is found that boll size and weight of seed correlate with four of the other six characters, lint per cent. with three, staple and lint index with two, per cent. 5-lock bolls with one, and seed per lock with none. Lint index and weight of seed, boll size and weight of seed, per cent. of 5-lock bolls and boll size, boll size and lint index, and weight of seed and staple give positive correlations, whilst weight of seed and lint per cent., lint per cent. and staple, boll size and lint per cent. give negative correlations. The work was carried out on selected cotton plants in South Texas.

127. TEXAS COTTON: CORRELATIONS. By K. L. Thadani. (Extracted from *Sum. Cur. Lit.*, vol. iii., No. 18, 1923, E. 35; and from *Agr. Journ. India*, vol. xviii., part 6, 1923, p. 579.) The author describes some studies on American cotton in which he has observed that there is a correlation between (1) seed "fuzziness" and amount of lint on the seed, and (2) vegetative colouring and fruiting habit.

In conclusion, it will be seen that there is evidence of the linkage of certain of the seed characters in American cotton. And this fact may be of great importance in breeding types of cotton of commercial value. In certain cases it will be impossible to combine characters which may be desirable, and this should always be borne in mind by those who are studying the crop. If partial linkage occurs, a much larger number of plants will have to be grown in the segregating generations than would otherwise be necessary in order to obtain the combination desired.

128. CORRELATION OF CHARACTERS. (Extracted from the *Work and Expend. of the Agr. Exp. Stations*, 1921, p. 27. Issued by U.S. Dept. Agr., March, 1923.) Cotton studies at the Texas station indicate a correlation of oil content with lint characters and protein, but not with total yield.

129. The Inheritance of the Number of Boll Loculi in Cotton. By S. C. Harland, D.Sc., F.L.S. (From *Journ. Text. Inst.*, vol. xiv., No. 12, 1923, T. 482.) The results of this work are disappointing, but the evidence goes to show that these meristic characters, as they are called, are inherited.

130. Crossing. (Extracted from the *Work and Expend. of the Agr. Exp. Stations*, 1921, p. 28. Issued by U.S. Dept. Agr., March, 1923.) Strains of cotton selfed for nine years at the North Carolina station show no lack of vigour, and the F_1 hybrids do not show exceptional vigour, which is contrary to what has been observed in case of corn. The natural crossing of cotton is found to be 4 to 6 per cent. only. As this plant has fifty-two to fifty-four chromosomes, there is a chance to combine several characters. Strains have been obtained that for seven years have varied in averages from 985 to 2,061 lbs. per acre of seed cotton, and from ¾ to 1⅛ inches staple.

131. Crop Improvement. (Extracted from the *Work and Expend. of the Agr. Exp. Stations*, 1921, pp. 39-40. U.S. Dept. Agr., March, 1923.) In cotton-breeding experiments at the Mississippi station, while Mendelian numbers were not obtained with many characters in crosses, they were obtained with lint, leaf colour, and smooth or fuzzy seeds. Considerable success has resulted from the breeding and selection work, and some seed has been distributed that has yielded 1½ bales per acre. An improved strain of Belton developed by the Texas station is being widely grown in some sections of the state.

In cotton-selection studies at the Arkansas station, "lint frequency" or "lint index" (the amount of lint on 100 seeds), rather than percentage of lint, is considered the proper basis to work from to increase the yield. It was found possible to increase the lint percentage, while the size of seed and length of lint were appreciably lowered.

Selection of cotton at the Alabama station has given an increased percentage of lint, but also susceptibility to anthracnose. A number of improved strains have been distributed, and are being widely planted. A variety which is quite wilt-resistant is now almost exclusively grown in some sections. A comparison of the yield from light and heavy seed gave 742 lbs. per acre for the latter and 600 lbs. for the former, the checks yielding 636 lbs.

In acclimatization tests with cotton at the Mississippi station, in co-operation with the North Carolina and Texas stations, Mississippi grown seed produced slightly earlier, taller, and higher yielding plants.

132. Egypt: The Methods Employed by the State Domains for Producing and Maintaining their High Standard of Sakel Cotton. (Pamphlet issued by Min. of Agr., Egypt; obtainable from Gov. Publ. Office, Min. of Finance, Dawawin P.O., Cairo.)

133. Pima Cotton: Pollination. By T. H. Kearney. (*U.S. Dept. Agr. Bull.*, 1134 [1923]. Abstr. from *Journ. Text. Inst.*, vol. xv., No. 9, 1924, A. 209.) Evidence is presented that, although the cotton flower is admirably adapted to cross-pollination, most of the ovules usually are self-fertilized. The percentage of natural hybrids produced when two distinct varieties or types are grown side by side ordinarily is not large. In the Egyptian type of cotton particularly self-fertilization has been found to predominate greatly over cross-fertilization. Investigations, which are described, of the structure and later ontogeny of the flower, of the deposition of self pollen and of foreign pollen upon the stigmas, and of the competition of like and unlike pollens, contribute to an explanation of the predominance of self-fertilization. Other aspects of the subject treated are the local and seasonal differences in the relative completeness of fertilization and the effect upon fertility of continued self-fertilization. Most of the data and conclusions relate to the Pima variety of Egyptian cotton, but comparison with Upland cotton has frequently been made.

184. UPLAND-EGYPTIAN COTTON HYBRID. By T. H. Kearney. (*U.S. Dept. Agr. Bull.*, 1164, 1923. Abstr. from *Journn. Text. Inst.*, vol. xv., No. 9, 1924, A. 209.) The Holdon variety of Upland cotton, a representative of the Texas big boll group, was crossed with the Pima variety of Egyptian cotton, and the resulting hybrid was studied in the first, second, and third generation. Detailed results of the investigation are given, and it is inferred that, although the data on correlation indicate relative freedom of recombination, the chances are heavily against the isolation and fixation of a productive type of cotton, combining the most desirable characters of both parents, from the segregation products of so wide a cross as that between Upland and Egyptian. It is also evident that accidental cross-pollination between these cottons cannot but greatly impair both the uniformity and the fertility of either type. Both conclusions are in agreement with the practical experience of cotton breeders.

185. THE TISSUE FLUIDS OF EGYPTIAN AND UPLAND COTTONS AND THEIR F_1 HYBRID. J. A. Harris, Z. W. Lawrence, W. F. Hoffman, J. V. Lawrence, A. T. Valentine. (*Journ. Agr. Res.*, **27**, 1924, pp. 267-328.) The relative capacity for growth and production of crops under special conditions depends ultimately upon intrinsic morphological and physiological differences, and a knowledge of these factors would provide a basis for the selection of varieties suitable for particularly stringent environmental conditions. The authors have made an intensive study of three such factors—the osmotic concentration, the specific electrical conductivity, and the acidity (hydrogen-ion concentration)—in the leaf-tissue fluids of Pima Egyptian and of Meade and Acala Upland cottons and of those of the F_1 hybrid between Pima and Meade cotton. The cottons were grown under irrigation in Southern Arizona, and comparisons made on a large number of subplots for samples taken in the beginning and end of August. The osmotic concentration of the leaf-tissue fluids was higher in Egyptian than in Upland cotton. Thus, the freezing-point depressions for plants grown from self-fertilized seed were 1·404 for Pima and 1·353 for Meade in the earlier series, and 1·298 for Pima and 1·212 for Meade in the later series. The differences for plants from bulk seed were smaller in amount, but generally significant. The electrical conductivity of the leaf-tissue fluids of the Egyptian cotton was significantly higher than that of either of the Upland cottons; the differences being from 3·0 to 3·8 per cent. in the first series and 8·2 to 9·2 in the second series. These values showed that the Egyptian cotton was capable of taking up from the soil and retaining in solution in the tissue fluids larger quantities of conducting electrolytes than the Upland cottons. The tissue fluids were acid in both types of cotton, the Egyptian cotton showing the higher acidity. Comparisons of the pH values for corresponding samples of plants from bulk seed gave 5·26 for Pima, 5·40 for Meade, and 5·30 for Acala. The tissue fluids of the F_1 hybrid of Pima and Meade had a lower osmotic concentration and a lower specific electrical conductivity than those of either of the parent types, and the hydrogen-ion concentration was intermediate between those of the parental types—E. M. C.

(*Cf.* also Abstracts 1, 2, 39, 50, 107.—ED.)

LEGISLATION.

From a further batch of ordinances received the following extracts have been made:

186. AUSTRALIA. The *Commonwealth of Australia Gazette*, January 24, 1924, proclaims *Platyedra gossypiella* (pink boll worm) as a disease.

The same number prohibits importation of cotton seed except at Brisbane, and under permission of the Minister. It must also be disinfected by heat, or other method, on arrival. Raw cotton may only be landed at Sydney, and must also be disinfected.

137. Fiji. Proclamation No. 10 of 1922 prohibits the importation of cotton seed or cotton without permit from the Superintendent of Agriculture.

Other notices in the *Royal Gazette* of September 22, 1922, define the area in which pink boll worm occurs, make regulations for destruction of cotton plants after picking the crop, as well as *Hibiscus esculentus*, and for destruction of plants affected with pink boll worm.

138. India. The Indian Central Cotton Committee publishes a list of by-laws in force in the various cotton markets of the Central Provinces.

139. Iraq. Various notifications prohibit import of cotton seed, the growing of varieties other than those approved, and provide for the licensing of gins, etc.

140. Nyasaland. Ordinance No. 8 of April 18, 1923, entitled "The Cotton (Amendment) Ordinance, 1923," amends the Cotton Ordinance of 1910.

141. The Rules of the Cotton (Amendment) Ordinance, dated May 28, 1923, enact for the burning and uprooting of all cotton bushes by the last day of October following the date of planting (with the exception of certain districts in which the date is extended to January 31); distribution of seed by Government; the retention by Government of any seed produced from the seed issued; inspection of cotton; the granting of purchasing licences; penalties for non-observance or breach of the Rules.

The Rules made the 21st day of May, 1920, are hereby repealed.

142. A Notification by the Director of Agriculture, No. 182, of August 15, 1923, gives revised dates prior to which all cotton plants must be uprooted and destroyed, *i.e.*:

Blantyre, Central Shire, Chiradzulu, Cholo, Mlanje, Ncheu, S. Nyasa, Upper Shire, Zomba	October 1, 1923.
Chikwawa, Lower	December 1, 1923.
Dedza, Dowa, Fort Manning, Kasungu, Kota Kota, Lilongwe, Mombera, N. Nyasa, W. Nyasa	February 1, 1924.

143. Queensland. (Abstr. from *Queensl. Agr. Journ.*, vol. xx., part 6, December, 1923, p. 446.) The Pure Seeds Act, 1913-1914, prescribes the following standards for cotton seed, under Schedule D:

Kind of Seed.	*Inert Matter.*	*Seeds of Weeds or Seeds of any Kind other than that to which the Sample Purports to Belong.*	*Seeds of Cuscuta spp. (Dodder), Datura spp. (Thorn apple), Ricinus communis (Castor Oil Plant), and Diseased or Insect-infested Seeds.*	*Dead and non-germinable Seeds.*
	Per Cent.	*Per Cent.*		*Per Cent.*
Cotton. (*Gossypium hirsutum*)	2	1	Nil	30

Percentages in respect of germinable seeds, dead and non-germinable seeds, are calculated by number, and, in respect of all other matters, by weight.

144. St. Christopher and Nevis (West Indies). Ordinance No. 5 of 1919 amends the Cotton Ordinance of 1918 in the definition of certain districts.

A Proclamation of December 11, 1920, prohibits importation of seed lint, or bags, etc., that have been used therewith, without permission.

Ordinance 12 of 1920 further amends the Cotton Ordinance of 1918 by proclaiming February as a close season and enacting that cotton plants shall be destroyed by burning.

A Regulation of February 4, 1921, required all seed cotton to be delivered to the ginneries by February 15, and makes further regulations for disinfection, etc.

Ordinance 5 of 1921 also further amends the Cotton Ordinance of 1918, requiring destruction of all old cotton plants by the beginning of the close season.

Separate regulations are also published for Nevis, Nos. 1 and 2 of 1921, 1922, and 1923, and Anguilla (No. 1 of 1921), dealing with the latest dates for delivery of cotton, disinfection, ginning, etc.

Ordinance 16 of 1921 still further amends the Cotton Ordinance of 1918 with regard to the destruction of all old cotton by burning.

Proclamation dated January 20, 1922, fixes the date, March 15 to April 15, as a close season for Nevis. This is rescinded by a later Proclamation of April 8, 1922, and March 15 to 31 fixed.

Proclamation dated March 17, 1922, fixes May 1 to June 1 as a close season for Anguilla. This is further rescinded, and February 1 to 28, 1923, fixed by Proclamation of December 20, 1922, whilst another Proclamation of December 11, 1923, fixes January 1 to 31 as the close season of that year.

Ordinance 6 of 1923 also amends the Cotton Ordinance of 1918.

145. St. Lucia (West Indies). A Proclamation, dated July 28, 1917, prohibits the importation of seed or seed cotton except from Grenada or St. Vincent.

146. St. Vincent (West Indies). Ordinance 6 of 1924 provides for the protection of cotton, requiring old plants to be burnt, fixing a close season, controlling ginneries, etc.

Regulations of March 11, 1924, give effect to these measures in some detail.

147. Virgin Islands (West Indies). The Cotton Protection Ordinance of 1922 makes regulations for the burning of old cotton plants, for the strict observance of the close season, for storage of cotton or seed, for the appointment of inspectors, etc. Further regulations under this Ordinance provide for delivery to ginneries by March 30, for early ginning, for fumigation of seed, licensing of purchasers, imposition of tax on sales, etc.

148. South Africa. (*Journ. of Dept. of Agr.*, vol. ix., No. 3, p. 209.) As a further precaution against the introduction of pink boll worm, the Agricultural Department has formally included, amongst the agricultural products, admissible only under special permit, "unmanufactured cotton, including linters and all kinds of unspun cotton waste, but excluding purified cotton-wool and cotton batting." The detection of any whole seed in the official inspection of a consignment would be deemed adequate justification for exclusion.

149. Uganda. The Cotton Rules of 1922, republished, enact for distribution of seed by Government, destruction of old plants, issue of licences to purchasers of raw cotton, opening of cotton markets, fixing of dates for the commencement of cotton buying, issue of licences for ginning and baling, etc.

150. Réglementation de la culture, de l'achat et du commerce du coton. (Notes from Brussels Exhibition.) By the courtesy of M. Lepläe, Director-General of Agriculture at the Belgian Colonial Office, I received a copy of the law that governs the culture, purchase, and commerce of cotton, applicable in certain districts of Belgian Congo, and to be applied in others at the discretion of the Governor-General.

The general regulations are much the same as in the British African Colonies, Section I. preventing the sowing of seed or the introduction of foreign seed other than authorized, obliging non-indigenous cultivators to inform the authorities about the area in cotton, to destroy old or diseased plants, etc.

In II., allowing the Vice-Governor of the province to fix a minimum price, permitting no intermediaries in purchase, preventing sale except at authorized ginneries, compelling verification of balances used (by the Director of Markets), and so on.

In III., purchasers must hold licences, and show that they can warehouse the cotton in good condition within 2 kilometres of the market.

In IV., the erection of new gins within a certain radius of the old is forbidden; seed from hand gins must be destroyed by fire or other approved method, and that from power gins held at the disposal of the authorities.

In V., the minimum equipment of a ginnery is specified, and the conditions under which it shall work.—Ed.

CHEMISTRY AND PHYSICS, ETC., IN THEIR APPLICATION TO COTTON PROBLEMS.

151. The Rigidity of Cotton Hairs. By F. T. Peirce. (*Journ. Textile Inst.*, 14, 1923, No. 1, pp. T. 1-17, figs. 12. Extracted from *Exp. Sta. Rec.*, vol. xlix., No. 2, 1923, p. 131.)

The resistance to twist and the forces involved by the twisting of cotton fibres may be expressed by the couple or twisting force due to one turn per cubic centimetre, termed the rigidity of the fibre, and derived in the formula $\Gamma=s^2.\eta\varepsilon$, in which s^2 is the square of the cross-section, ε the geometrical form and η the rigidity (the ratio between the tangential force per unit area and the angle of shear it produces).

The mean values of fibre rigidity, tabulated for cottons ranging from the finest Sea Island to the coarsest Indian, show a large increase with coarseness of the cotton, and are approximately proportional to the inverse square of the staple length. For this reason a higher constant must be used in calculating the spinning twist for shorter cottons. Random picking from lightly combed seed gives the most satisfactory and representative result of the methods of sampling.

Correlation was found between the rigidity and the ribbon width, length, and mass of the fibres. The values of these quantities showed that the effective shape of cross-section may be considered as a rectangle with semicircular ends, in which the ratio of wall thickness (half the least diameter) to ribbon width (greatest diameter) varies from 0·2 to 0·3, and gives a coefficient of rigidity for the cotton cellulose of about $0{\cdot}23\times10^{11}$ dynes per square centimetre, one-tenth that of glass. The values of fibre weight agree with those of length and rigidity in showing that fibres of all kinds have an approximately constant volume of cellulose which is independent of staple length, but varies with growth conditions.

The statics of a newly spun yarn and the value of the geometrical constant $\varepsilon=\Gamma/\eta s^2$ are also considered.

(From the *Shirley Institute Memoirs*, October, 1923, vol. ii.)

152. The Lustre of Doubled Yarns. By Albert Adderley, A.R.C.S., B.Sc., A.Inst.P., and Arthur Ernest Oxley, M.A., D.Sc., F.Inst.P.

153. Some Physical Tests on Sized Yarns. By Albert Edward Owen, B.Sc., A.Inst.P.

154. The Plasticity of Cotton and Other Materials. By Frederick Thomas Peirce, B.Sc., A.Inst.P.

155. The Flow of Starch Paste through Capillary Tubes. By Frederick Denny Farrow, M.Sc., and George Morris Lowe, A.R.C.S., B.Sc.

(From the *Shirley Institute Memoirs*, December, 1923, vol. ii.)

156. The Measurable Characters of Raw Cotton. I. The Determination of Area of Cross-Section and Hair Weight per Centimetre. By Gladys G. Clegg, M.Sc., and S. C. Harland, D.Sc., F.L.S.

(From the *Shirley Institute Memoirs*, January, 1924, vol. ii.):

157. The Measurable Characters of Raw Cotton. II. The Breaking Load of Single Cotton Hairs. By Gladys G. Clegg, M.Sc.

Introduction.—Except for the work of O'Neill* and Heilmann,† it was not until recent years that any work had been done on the tensile strength of single cotton hairs. In 1912 Balls‡ published several data on the strength of lint, and his conclusions may be summarized as follows: (1) The breaking strain of a fibre is very largely determined by the thickness of its cell wall; (2) the determination of strength by the grader resolves itself into a test of regularity of strength.

The investigations described in this paper fall under the following heads:

(i.) Breaking load of single hairs of several varieties of cotton.
(ii.) Correlation of the breaking load with convolutions, wall thickness, etc.
(iii.) Breaking load of single hairs of three of the cottons after mercerization.

158. Neps in Cotton Fabrics and their Resistance to Dyeing and Printing. By Gladys G. Clegg, M.Sc., and Sydney Cross Harland, D.Sc., F.L.S., F.E.S. (Extracted from the *Agr. Journ. of India*, vol. xix., part 1, 1924, pp. 69-80.)

The Introduction gives a summary of the work of Crum, Haller, and Herzog.

The results of microscopic examination of an alizarin-dyed fabric which showed motes and streaks are presented. The conclusion is drawn that the defect is one essentially similar to that described by Crum, and is attributable to neps composed of thin-walled hairs. The difference in colour of the neps is considered to be mostly optical in nature, for reasons which are given, but the nep aggregate apparently contains debris of hairs consisting of primary wall only, which are glassy in appearance and remain undyed.

The effect of mercerization on the difference in colour shown by neps in an indigo-dyed fabric is to render such difference less conspicuous. This is considered to be due to alteration in the shape of the cross-section, reducing dispersion effects, and to an increase in the wall thickness, which causes an increased capacity for dye.

The cell-wall thickness of cotton hairs is considered in detail, and reference is made to recognized causes of neps during manufacture.

The effect of environment and genetic factors on cell-wall thickness is shown to be complex, and it is concluded that much of the thin-walled cotton arises through death of seeds before maturity, either through competition, genetic factors, or attack by parasites.

Elimination by genetic methods of strains characterized by excessive amounts of thin-walled cotton is suggested to the cotton breeder, as well as a detailed study of the physiological and genetic factors influencing its amount.

159. The Salt Content of Cotton Fibre. T. H. Kearney and C. S. Scofield. *Journ. Agric. Res.*, 28 (1924), 293-295.

Pima cotton, a long staple variety of the Egyptian type grown under irrigation in Arizona, is said to be difficult to spin when the humidity of the air is high, and it has been suggested that this might be due to a high salt content taken up from the saline soil. The authors find, however, that the salt content of the fibre of the Pima cotton is not appreciably higher than that of Sea Island or Upland cotton grown either in South Carolina or under irrigation in Arizona. Further, the capacity of Pima cotton fibre for hygroscopic absorption of water is not materially affected by removal of the readily water-soluble salts.—[E. M. C.]

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* Mem. Lit. and Phil. Soc., Manchester, November 17, 1863.

† Bull. Soc. Ind., Mulhouse, 1826.

‡ "The Development and Properties of Raw Cotton," London, 1915.

MISCELLANEOUS.

160. AMERICAN COTTON: GRADING. By H. C. Taylor. (Abstr. in *Journ. Text. Inst.*, vol. xv., No. 7, 1924, A. 162.)

161. MARKETING SOUTH AFRICAN COTTON IN EUROPE. By Th. G. Hesse, Government Cotton Grader. (*Journ. of the Dept. of Agric., South Africa*, vol. ix., No. 3, 1924, pp. 232-238.)

162. HOW THE CARRY-OVER IS MEASURED. POINTS IN COTTON ACCOUNTANCY. By John A. Todd. (*Manch. Guard. Comml.*, Ann. Rev. of Amer. Cotton, August, 1924, p. 33.)

163. THE POST-WAR DEPRESSION IN THE BRITISH COTTON INDUSTRY. By Prof. G. W. Daniels, M.A. (Manchester Statistical Society, Manchester.) A statistical study.

164. The Editorial in the *Experiment Station Record* for June, 1924, discusses the work now in progress in the British Empire, and gives a general review of the activities of the Empire Cotton Growing Corporation, the British Cotton Growing Association, and other bodies as viewed from an American standpoint.

165. THE EFFECT OF THE OPENING PROCESSES UPON THE STAPLE OF COTTON. By G. A. R. Foster. (Abstr. in *Journ. Text. Inst.*, vol. xv., No. 7, 1924, T. 363.) The question whether damage is done by the opening processes to the staple of cotton has been investigated by examining samples drawn from the machinery in four mills.

166. COTTON STATISTICAL SERVICE. (Issued by the Merchants' National Bank of Boston, Mass., U.S.A.). With a view to keeping its customers in the cotton trade closely informed regarding basic conditions in the industry, the Merchants' National Bank of Boston is issuing a comprehensive cotton statistical service. This consists of a volume in loose-leaf binder entitled *Statistical Analyses of the Cotton Industry*, weekly addenda of current figures, and periodical analyses of important developments in the industry.

The volume in the loose-leaf binder contains approximately fifty tables covering all fundamental phases of the cotton trade, including acreage, production, supply and distribution, carry-over, movement into sight, exports, takings, prices of yarns and fabrics, manufacturing margins, and percentage activity of the industry.

The statistics cover foreign (of course chiefly Indian and Egyptian) cottons as well as American. They extend over several years, and are so arranged that major trends and yearly comparisons may be seen readily. Some of the figures are merely tabulations of standard data of the trade, but others are special analyses and comparisons which help to bring out fundamental conditions of supply and demand of the staple.

The service is directed by Mr. Alston H. Garside, Manager of the Industrial Service Department, formerly statistician of the National Association of Cotton Manufacturers, who has been engaged in cotton statistical research for ten years. The bank has prepared this service primarily for its larger commercial customers; it is making a charge for it to non-customers.

PERSONAL NOTES

APPOINTMENTS.

Mr. G. S. Cameron, late of the Department of Agriculture, Iraq, has been appointed by the Corporation as Cotton Specialist attached to the Department of Agriculture, Southern Rhodesia.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes " home " on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street) immediately opposite to the offices of the Crown Agents for the Colonies.

Ceylon	Mr. F. A. Stockdale.
Gold Coast	Mr. J. M. Dunbar.
,,	Mr. H. K. Hewison.
,,	Mr. C. Saunders.
,,	Mr. M. Vardy.
Nigeria	Mr. W. B. Dowson.
Nyasaland	Mr. E. J. Wortley.
Palestine	Mr. J. Abul Kheir.
Tanganyika	Mr. A. H. Kirby.
Uganda	Mr. C. Hazel.
Zanzibar	Mr. H. Waterland.

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SOUTHERN RHODESIA

WITH SPECIAL REFERENCE TO THE PROSPECTS FOR COTTON.

BY

ERIC A. NOBBS, Ph.D., B.Sc., F.H.A.S.
Director of Agriculture, Southern Rhodesia (retired).

IN a figurative sense cotton binds one portion of the British Empire to another as surely as the threads hold together these pages. It is well that the spinner, the weaver, the vendor, and the buyer of the finished goods should know something of the prime producers in the distant countries from which their wares originally come. Similarly the growers are, and ought to be, interested in the processes through which their product has to pass before it reaches the consumer, and should understand the conditions of life of those who toil in the distant manufacturing cities.

The benefit to be derived from such knowledge is not only sentimental, but also very practical. The manufacturer should know the possibilities of the country of production, the limitations of the producer, and the peculiarities to be expected from the lint from any particular source, be they merits or defects. The grower should understand the requirements of the manufacturer in order to meet them as far as possible, and so furnish the article most desired, often possible but not always understood. On the one hand, mutual knowledge will enable the farmer to provide cotton in the form and manner desired, thus effecting economy in subsequent handling by attention to details to which the buyer attaches importance. On the other hand, such intimacy may induce the manufacturer to make allowance for the commodity as furnished to him, even though it may be different from what he is used to from other sources. Comprehension of the other man's circumstances may induce the buyer to pay the uttermost farthing in the hope of establishing a permanent supply, and may make him realize what the grower must be paid in order to induce him to continue growing. By knowing what happens to his cotton the farmer may be helped to appreciate why there is that, to him, enormous difference between the prices of cotton as he grows it and the resulting fabric as sold back to him in due course.

For these reasons it seems well to give some account here of the conditions of Southern Rhodesia not only as regards cotton, but in respect of the daily life, conditions, and problems of the farmers, the natives, and the rest of the population. On these subjects much has, of course, been said and written, but not with an eye upon the cotton question, which is quite a new factor in the economic prospects of the Colony.

To this end a statement of actual facts rather than of pious opinions and aspirations is called for, entailing, as a penalty for its endeavour to be instructive, the necessity of proving its points by the dull process of quoting statistics rather than by the more entertaining method of furnishing fancy-free platitudes.

It may be permitted here to mention that there is a mass of informative literature on the prospects of the country, dealing faithfully with advantages and drawbacks. It is readily obtainable from the Settlers' Board, Salisbury, an officially appointed unpaid body concerned in advising and helping newcomers, or from the agency of the Government in London. At the British Empire Exhibition in London there has been a Rhodesian section attended by experienced officials where much information regarding the country has been disseminated to eager enquirers.

To those whose homes are in Rhodesia it seems incredible that anyone should not know where their country is, yet many do not, and so, without insinuating ignorance on the part of any particular reader, it may be permitted to explain just where on earth it lies. Rhodesians, being few and far away, are very sensitive on these points. The country lies very close to the hearts of its inhabitants, between heaven and the other place, but intruding into both. Geographically, Southern Rhodesia is situated between 15° 35′ and 22° 30′ south latitude, and 25° 22′ and 33° east latitude, and between 2,000 and 9,000 feet and chiefly 3,000 to 5,000 feet of altitude. It lies between the Zambesi River to the north, the Limpopo River to the south, the Chimani-mani mountains on the east, and the Kalihari desert on the west. Another description gives it as between Northern Rhodesia to the north, Bechuanaland Protectorate to the west, the Union of South Africa to the South, and Portuguese East Africa to the east. In other words, the youngest British colony lies between the Central African and the South African States.

Let it be understood once and for all that we are dealing with Southern Rhodesia only, not with its northern half-section.

Only one-third of a century has passed since the country was in a state of complete barbarism. It was in part occupied by a fierce and warlike people, the Matabele, under their rulers Mziligazi and his son Lobengula, who kept their thrones by bloodthirsty tyranny, and the rest was inhabited by a number of distinct tribes, now classed as Mashonas, who were vassals of their bellicose neighbours, paying tribute and yet suffering from periodic raids, when the men were killed, the women and children massacred or taken off into slavery, and the cattle, of course, driven off.

The history of Rhodesia has been a romance, too recent to be classic, and not to be called heroic only because so many of those who played a part are still amongst us, and tinged always with the idealism of the great founder whose name the country proudly bears. This wide domain in the remote parts of Africa was seized and held by a commercial company registered in the city of London. Its original shareholders were actuated largely by patriotic motives expressed in cash, just as the band of pioneers, soldiers, miners, farmers, and politicians, who furnished their personal services towards the same end, were largely influenced by the spirit of adventure, ambition, and love of country. Both these mutually dependent sections were alike animated by the ideals and principles of Cecil John Rhodes.

Under a royal charter granted in 1889 Mr. Rhodes and his friends set out to make history, and to cut a long story short, have developed the country to its present advanced stage of settlement and prosperity with practically no debt, since the Imperial Government has never permitted the revenues of the country to be pledged for the purpose of raising a loan, so that on termination of the charter last year the liabilities were only £2,800,000, all represented by tangible assets. Expenditure was raised from current revenue, even for capital expenditure, in the benefits of which future generations participate. It is an interesting commentary on this point that the new Government as one of its first acts has obtained a loan of £3,000,000 to cover the above liability and provide for reproductive works, and a further £500,000 is being raised over and above the resources of a buoyant revenue.

The present happy position of the country has not been attained without difficulties, setbacks, and disappointments. Native troubles occurred in 1893 and 1896, when many lives were lost. The Boer War of 1899-1902 paralyzed progress for the time, and the Great War of 1914-18 called up the bulk of her manhood—without need of conscription, be it said—and interfered with the development of the country for a decade.

Disease of cattle, too, has been a serious obstacle, for cattle mean not only meat, but also transport and farm labour. Lack of a seaboard has left Rhodesia at a disadvantage, a fact not lost sight of by her more advantageously situated neighbours. Measured with certain other countries, perhaps, our statistical figures appear insignificant, but where given it is to be recollected that they represent the present position as reached in thirty-four years from unalloyed savagery, and that in that time 2,462 miles of railway had to be built, towns created from the grass sods, industries established, mines found, developed, and worked, a network of roads made, and agriculture organized.

In terms of the charter good government had to be provided; this entailed not only an administration to govern the civilized community, but also to rule the natives, who, after having been subjugated, have been dealt with justly, wisely, and generously, and in such a way as repeatedly to evoke the approbation of the Colonial Office, representatives of other British and foreign colonies, and of responsible missionary bodies, who recognize the good results of the policy adopted.

The (at present) final stage in its history was realized by the incorporation of the country into the British Empire on its formal annexation, and the simultaneous inauguration of a form of responsible government in October, 1923. A new era, politically and economically, has thus dawned for Rhodesia. That portion of the company's territory north of the Zambesi has become a Crown colony, and that to the south a self-governing colony. Nothing is perhaps more characteristic and suggestive than the fact that one of the chief events of local interest since the date of the change of Government has been a keen and widespread interest in cotton, culminating in the opening of a well-equipped ginnery in the capital, three days after the opening of the new Legislative Assembly.

Statistics are a weariness, yet figures are a necessity to give an indication of the actual scale of operations in Rhodesia, without which a very false impression, either way, may be formed. The latest available census—that for 1921—shows 33,620 Europeans, an increase of 42·42 per cent. in ten years. An analysis of the census returns shows that 24·54 per cent. of the European population was engaged in agriculture, 12·84 per cent. in mining, 16·79 per cent. in commerce, 14·55 per cent. in the public service, 10·1 per cent. in industries, and 11·08 per cent. on the railways. The native population is 862,319, an increase of 15·81 per cent. in a decade, and representing 96 per cent. of the whole, whilst only 0·36 per cent. of the population is classed as Asiatic and coloured.

All manual work in the country is done by natives, who, with proper supervision, are capable and willing workers. Of the labour, agriculture employed 41·72 per cent., mining 31·36 per cent., domestic service 10·56 per cent. In regard to the population it may be of interest to note that the great majority is of British origin both in the towns and the country, mainly from the Union of South Africa and the old country, but not a few from Australia, New Zealand, India, Canada, and some from South America. In certain districts Boers from the Transvaal and the Cape predominate, but live in complete amity with their neighbours, though without showing much tendency to coalesce into one nation. All, however, regard themselves essentially as Rhodesian first, members of the British Empire, and only Dutch or British as a subsequent distinction and an accident of birth. In all districts are found a sprinkling of foreigners, such as Swiss, German, French, Russians, Jews, and Greeks, the last three more often as country storekeepers and native traders than as farmers.

Normal life in Rhodesia is difficult to define or describe, because it is not yet stable and there are no very large sections leading the same existence and so furnishing a definition of what is normal. The community is divided according to vocations more than by any other social distinction. In a land where the vast majority is still the uncivilized native all white men are aristocrats, and for this reason amongst themselves the European inhabitants of Southern Rhodesia are most democratic and equal. There are hardly any idle in the sense of leisured or retired; there are few rich as riches go elsewhere; but there are also relatively few unemployed and indigent; though, on the other hand, there is little scope at the moment for those seeking work. Openings of any description, for artisans, clerks, shopmen, farm hands, farmers, or for professional men, civil servants, or other earners, are almost unobtainable except occasionally by the lucky man on the spot. For the capitalist, small or otherwise, especially if knowledge of some branch of productive industry is included in his capital, there is always not only room, but a real need. As to life in Rhodesia, visitors who know other colonies and dominions are emphatic in their assertions as to the strong British sentiment they observe here, in traditions, manners and ideals, as well as in work and play. Lacking necessarily all that is associated with great cities, there is yet sufficient social gaiety and intercourse to render existence pleasant without being strenuous. Ample occupation for the mind can be found in one's business, in domestic duties, charities and good works, or the study of such sciences as are peculiarly attractive in an old new country.

Without entering either upon the domain of the historian or the partisan, it may be permitted to remind the reader that since Mr. Rhodes first conceived his great project Rhodesia has been governed by, and at the cost of, the British South Africa Company with a minimum of help or interference from the Colonial Office as representing the Crown; that this great land, conquered, pacified, and occupied under the ægis of the board of a commercial company, has been developed, exploited, and civilized by a number of miners, farmers, and the servants of the company; and that only a short year ago has it achieved the dignities of a self-governing colony of the Empire. What the future has in store none can tell, and to endeavour to forecast it would be injudicious, but there need be no reason to suppose that it will be other than prosperous and progressive, and, let us hope, profitable to all concerned. This much is certain, that the future political destiny will be exceedingly interesting and will be closely watched and vigorously striven for by the very virile, mentally and physically alert men and women—for the franchise includes the fair sex—who have made Rhodesia their home, and by those who care to join them now when a new turn has been given to the wheel of the national fortune. So much for the political situation.

In endeavouring to convey an impression of the manner of life led by Europeans in this remote part of Africa, no aspect is perhaps more illuminating than the position as regards education. No young country has ever put forth more strenuous efforts to grapple with its educational problems, and the ladder from the lowest rung up to the end of the secondary stage is complete.

The scattered nature of the rural population is the main difficulty, but is met as far as possible by farm, and aided private, schools. Vocational training in commercial and domestic subjects and handicrafts is provided, and at the Matopas a school of a primary character giving a general education with a strong agricultural bias has lately been established.

Liberal educational endowments have been showered upon the country, including the Rhodes Scholarships tenable at Oxford University, where the fortunate holders meet others from all parts of the British Dominions and the United States of America in accordance with the far-sighted intention of the great benefactor of the country. The numbers of children attending schools in Rhodesia in 1923, apart from a number who are sent to the Union or to England, were 6,288 boys and girls. So it will be seen that education is not neglected nor behindhand. Native education is mainly provided by missions, with a generous measure of Government support.

Southern Rhodesia, though in tropical Africa, is by no means an unhealthy country, and in many respects compares favourably with more advanced and densely peopled countries. The European death-rate for 1922 was 10·09, and for 1923 11·21 per 1,000, figures which compare favourably with most other parts of the world. Malaria occurs, but if proper precautions are taken, infection to a great extent can be avoided. The birth-rate in the year 1923 was 25·88 per 1,000. The children born and reared in the territory are particularly healthy and vigorous, and free from many of the afflictions of other countries.

Although Rhodesia lies within the tropics, the climate is almost temperate, with a cold, dry season, when often at night there may be a touch of frost. From September onwards the days turn warmer though the nights remain cool. On the approach of the rainy season the sky becomes cloudier and the nights rather warmer, until about November and December it is quite hot, though never so trying as in equatorial climes. The rains break any time in November or December, and the active growing season commences with weather warm enough for maize, cotton, and millets, though not too hot for crops associated with the temperate zone. At the end of March the rains normally cease, and a rapid fall of temperature takes place, checking all growth and debarring the cultivation of crops of true tropic character requiring perennial heat and moisture. The climate may, therefore, be generally described as varying from temperate for localities at an altitude above 4,000 feet, to subtropical for localities under 3,000 feet altitude. The early rains are characterized by heavy local thunder showers with bright interludes of several days. From December general rains lasting several days—the so-called monsoon type of weather—predominate. The cessation of the rains is usually almost sudden and complete. It is on record that occasional showers have fallen in every month of the year, though from May to September this is very rare, and continuous fine weather is the rule. The coldest months are June and July. Undoubtedly the climate of Rhodesia constitutes one of its chief charms as well as one of its most valuable assets. On the western and southern border the mean rainfall is under 15 inches. As one travels eastwards and north rain becomes more generous and copious until on the high eastern border on the Portuguese boundary it is actually excessive, averaging 40 inches, and occasionally reaching 60 inches in one year. The mean rainfall of the whole country is 28·2 inches. Over the major portion of the country the rainfall varies from 25 to 40 inches per annum, distributed favourably during the summer season. The mean annual temperature over the bulk of the country is 66° F., with a mean annual maximum of 78° F. and a mean annual minimum of 54° F. For cotton earlier rains and a hot, dry spell at the end of the season would be better, but even as things are it seems likely that over large parts of Rhodesia a fairly favourable season for cotton can be relied upon. Notoriously the cotton crop, in most countries where it is grown, varies from year to year, even when water is supplied artificially by irrigation, and this new cotton area cannot be exempt, but so far as climate is concerned, over wide regions cotton is likely to succeed in most years and never fail completely.

The area of Southern Rhodesia is 153,247 square miles, but in view of the existence of certain tsetse fly belts this, for practical purposes, may for the present be reduced to 144,800 square miles or 92,672,000 acres. Of the whole country about one-half is unalienated, one-fifth is native reserves, one-fifth is owned and beneficially occupied by Europeans, and the remainder, or about 14 million acres, is privately owned but not yet utilized. It will therefore be seen that the primitive stages have been passed through, but that there is ample room for further development.

As regards accessibility to railways, about one-third of the country is within 25 miles, over a quarter lies from 25 to 50 miles, and the rest is beyond that distance from the line.

There is, it will be seen, much land as yet unoccupied, even of that privately owned, and there is great scope for the pastoralist on a big scale as well as for the arable farmer, and for all gradations between these two extremes.

Land is held in Southern Rhodesia under a variety of titles, but on the general basis of freehold ownership acquired by purchase outright or in instalments, and subject to reasonable stipulations as to occupation and development. Leases such as obtain in certain of the Crown colonies are not in vogue, and would not be favourably regarded. Certain reservations, however, exist, such as right of outspan for travellers and stock, rights for roads and telegraph lines, and expropriation for public purposes, also in mining areas rights regarding claims and the use of wood, water, and grazing.

The territorial needs of the natives are secured to them through numerous large reserves in which communal forms of settlement are followed. There is nothing to prevent natives buying or leasing any land, whilst many reside permanently on farms, paying rent or providing labour. Land is readily bought and sold and given as security for loans on mortgage, so that it is evident that the acquisition of title presents no difficulties.

Salisbury, the capital of the colony, was founded in 1890. The mushroom mining camp which then arose has since blossomed forth into a centre of civilization of 6,000 Europeans, including 1,000 children in its schools, with imposing business edifices, hotels, theatres, and Government buildings, with wide streets well laid out and pleasant residences set in umbrageous gardens.

Of industries Salisbury has already a fair beginning, including maize-mills, a butter factory, two bacon factories, two oil mills, candle and soap works, furniture works, fertilizer works and biscuit factory, brewery and tobacco warehouse, and, what will chiefly interest readers of this Review, a newly erected cotton ginnery.

The altitude is 4,830 feet, the rainfall 32 inches, and the mean maximum temperature in the shade is 84° F. in summer and 71° F. in winter, so that the climate may be regarded as good in spite of the fact that the sea is 300 miles away.

Bulawayo is the largest town in Southern Rhodesia, exceeding the capital by a few hundreds in population. It is commercially more important, being the headquarters of many mining and land companies and of numerous mercantile firms trading with the Belgian Congo, Northern Rhodesia, and Bechuanaland, as well as with the miners and farmers of Matabeleland.

There are several other townships owing their existence to the mining and farming interests of the country, notably Gwelo, Umtali, Sinoia, Victoria, Plumtree, Belingwe, Enkeldoorn, Que Que, and others.

Gatooma is likely to acquire a new importance; most successful experiments in cotton growing have been recorded from this locality, and the yield and quality of considerable acreages this last year have been most encouraging. The altitude is in the neighbourhood of 4,000 feet, the rainfall 30 inches, and the climate fairly warm and free from frost. The Government, through the Department of Agriculture, has established quite recently in the immediate vicinity of Gatooma an experiment station for the culture particularly of cotton, where the trial and acclimatization of varieties from all parts of the world will be conducted, also the improvement of varieties by selection and breeding, and experiments in cultural methods and the use of fertilizers. This undertaking should give a special fillip to cotton cultivation in the Hartley district, but is also intended to serve the whole country.

Although, as shown by returns, mining brings money into the country much in excess of the value of the exports produced by farming, yet agriculture supports a much larger portion of the population, and its products are very largely, indeed mainly, consumed within the country, while, so far as mining is concerned, this is only true of a little coal and arsenic. There are upwards of 2,800 occupied farms in Southern Rhodesia, giving direct occupation to fully twice that number of white men, and of course a much larger number *indirectly. Southern Rhodesia is therefore essentially an agricultural country, although it is frankly recognized that it would never* have become such but for the existence of its mineral wealth. To-day and for all time by far the greater part of the occupied country will be devoted to the pastoral forms of agriculture, since, owing to its rocks, its configuration, the physical and chemical nature of the soil, and to climatic causes, much of the country can never become arable land. It will not, therefore, pass like Australia and South America through a ranching stage followed by subdivision of the larger holdings into smaller ones, except in certain favoured localities where cattle runs have been established on land capable of better utilization, but such cases are rare. Originally the country was parcelled out into farms of 3,000 acres in Mashonaland and 6,000 acres in Matabeleland, without much regard to quality. As a result most arable holdings are too large for economic management, and in other cases farms have had to be grouped together to make a reasonable ranch. The cutting-up process is proceeding in the more fertile areas, and elsewhere new ranches are being selected on a more appropriate scale, several large blocks having of late been taken up in regions specially adapted for cattle.

The total area of summer crops under cultivation by European farmers last year was 266,607 acres, to which may be added for winter crops a further 10,000 acres. Of this area 82·9 per cent. was devoted to maize, 3·4 per cent. to tobacco, 2·1 per cent. to groundnuts, 1·3 per cent. to sunflowers, the rest being under various crops for fodder purposes and local markets. The great bulk of these crops are grown in the districts of Mazoe, Salisbury, Lomagundi, and Hartley, but there is no question that extension of communication in other districts will render them productive of crops to a much larger extent than is the case to-day.

The agricultural development of Southern Rhodesia has now reached a position in which the methods of production in regard to a considerable variety of articles are fairly well understood, so that, given outlets, large quantities could readily be assured and of a quality known to be commercially satisfactory. Until such production could be guaranteed it was useless to attempt to seek markets. The whole of South Africa already has an unenviable reputation for the production of samples, and *until* truckloads, train-loads, or cargoes could be delivered it was hopeless to discuss prices. Now, however, the farmer is awaiting only the buyer's assurance that he will purchase the crop when grown, but necessarily the farmer must have some reasonable prospect of selling it before committing himself to the risk and outlay involved in growing a crop or preparing a product. Previously there was much uncertainty as to whether and how things could be produced; now, very largely, we know, but are faced with the problem of how to sell to a profit. This economic problem of guaranteeing to the farmer markets for his tried and proved crops is to a large extent the crux on which depends the development of many branches of agriculture. It is especially true of cotton and cattle and also applies to such crops as ground-nuts, tobacco, sunflower, niger-oil, beans, chillies, and even to some extent to maize and oranges. Markets have been found for maize, but new and better ones are wanted. Cheese, butter, and eggs are being produced, and have so far met ready markets, but further outlets will have to be developed to meet growing needs.

Cotton has not till now figured amongst the principal exports of the colony, which in order of value consist of gold, asbestos, copper, chrome, maize, tobacco, cattle, coal, oranges, hides, timber, and butter. The total value of exports, according to customs returns, of the products of the country during 1923 was £4,916,121, of which, after providing for local needs, those of an agricultural character amounted to £804,558. The principal agricultural items were: maize and maize-meal £359,316, cattle £168,572, tobacco £196,839, oranges £31,977, and hides and skins £47,259. Cotton for this year will probably exceed £30,000 in value. It should never be forgotten that, except in the case of tobacco, oranges, and hides, and to some extent even in these cases, these exports represent the surplus over and above the needs of the country.

The value of all forms of local produce exported into the Union of South Africa from Southern Rhodesia amounted to £517,825 for 1923, and to Southern Rhodesia from the Union the corresponding figure was £807,908.

Before dealing further with the position of the agricultural and mining industries of Southern Rhodesia it may be appropriate here to discuss the past, present, and future of cotton as a crop. Away back in 1903 a company was formed to grow cotton, and it is on record that some was produced, but there was no commercial profit, and at the prices then obtainable and against the difficulties of transport prevailing it was impossible to achieve success, and the matter dropped for a long time, though the company is still in being. Since then, at intervals, further experiments were made, but without sufficient prospect of financial success to warrant practical application. In 1908 experiments were begun in Northern Rhodesia and a ginnery even was established, but results were so discouraging that no commercial development followed at that time. In this connection it will be remembered that cotton was virtually not grown in the Union prior to 1916, and in 1915-16 in Natal only 10 acres were cultivated, yet five years later, in spite of many failures, 10,000 acres were grown.

The discouraging results in all the early attempts to grow cotton in Southern Rhodesia have been mainly due to want of knowledge of practical details. By these partial failures valuable experience has been acquired. Planting distance, season, soils, have much effect on the resulting crops, whilst selection of variety, treatment of the crop, and economy in harvesting are matters of fundamental importance. Much is still being learnt on these points, but beginners to-day are being taught the best methods learnt by past experience, thereby increasing the measure of their success.

In 1917 it was decided that altered circumstances warranted cotton being given a full and fair trial in spite of past failures, and this policy has, from that date, constantly been carried out, and has been amply justified by results. The following year a cotton expert was appointed and attached to the Department of Agriculture, who, however, was required to devote much time to tobacco also, and three years later an assistant cotton and tobacco expert was added. By these means the technical details of the subject were made available to those who wished to test the possibilities of cotton. All has, however, not been smooth sailing, and the present promising position has only been reached after many vicissitudes. Until 1919 no one wanted to grow cotton, for there was insufficient inducement to awaken any such desire. In that year ninety-one farmers scattered over several districts planted trial plots ranging from 1 to 50 acres. The results obtained varied from absolute failure in some cases to satisfactory yields in others, but the quality of the lint produced was favourably reported upon by brokers and manufacturers in Great Britain and evoked much interest at the local agricultural shows. Prices offered were an improvement compared with former years, but railage and freight were prohibitive and the prospects of profitable production were discouraging. Proposals for stimulating the cotton-growing industry were discussed that year between the Administration, the Secretary of State for the Colonies, and the Empire Cotton Growing Committee.

During the season 1919-20 cotton seed was distributed to farmers by the Department of Agriculture and the Farmers' Co-operative, Ltd., and 711 acres were planted. Although the crop made excellent growth the final results were not very satisfactory, attributable chiefly to ignorance, late planting, and unfavourable weather. In that year a small ginning plant was obtained through the British Cotton Growing Association, which met half the cost, the balance being provided by the Co-operative Society and the Administration jointly. The gin was adequate for the quantities of cotton then available, but the press provided was only sufficiently powerful to bale the cotton to a density of 6 lbs. per cubic foot, quite inadequate for ocean transport. No delinter was available, so that the seed could not be prepared for treatment in the local oil factories, nor the lint put in proper order for export, and the whole resulting crop was sold locally at 6d. per lb. for upholstery purposes.

The British Cotton Growing Association offered substantial prizes for the year 1920, but little cotton was planted. For reasons indicated above the ginnery was not operated and most crops were not even harvested. Prices for cotton offered no inducement to push production, whilst efforts to secure the services of an additional expert to study the cotton question, to advise the Government and growers, and to conduct experiments led to no result. The cotton propaganda therefore received a setback. Cotton in 1922-23 extended to only 21 acres of experimental plots.

A recovery and renewed interest arose in 1923-24; the higher prices offered and the propaganda for all-British cotton have altered the position materially, and about 3,000 acres or more of cotton were planted throughout the colony. About 55 tons of medium staple American Upland cotton seed were imported from the Union for planting purposes, but on account of the first rains being exceptionally late the full acreage anticipated was not planted. Many farmers put in up to 150 acres, though most were content with experimental plots of an acre or two. Good crops resulted in the Mazoe Valley, in the Hartley, Lomagundi, Makoni, Wankie, Gwanda, Bubi, Bulawayo, Victoria, Nyamandhlovu, and Melsetter districts, although the season was one of short rainfall erratically distributed. Cotton promises to do best in the zone between the more elevated cold and exposed plateaux and the low-lying, hot, but semi-arid valleys.

This brings us now to the present stage. The success of cotton growing last season led to the erection of a ginnery at Salisbury capable of dealing with much more than the output yet in sight. This ginnery, which is the private enterprise of Major Cooper, D.S.O., consists of spacious brick buildings conveniently situated on the edge of the town, with its own railway siding. The electric current is supplied by the municipal power plant and drives all the machinery, consisting of the delinting plant and the special 50-saw gin used for ginning selected seed, press conveyers and fans, and suction cleaners. The ginning plant itself consists of a battery of three eighty 12-inch saw gins made by the Continental Company of Birmingham, U.S.A. After ginning, the lint, thoroughly cleaned, is forced by compressed air on to the condenser on which the lint adheres, whilst the dust and small particles are blown through the gauze and out through the uptakes at each end. The lint is pressed by the hydraulic press to a density of 16 to 18 lbs. per cubic foot, according to the type of cotton. After ginning, the seed is taken by a system of conveyers and elevators to the delinting room, where the seed is finally cleaned and bagged. The ginnery cost about £10,000, and has recently commenced operations. It is calculated that from the moment of delivery by the farmer of his cotton at the ginnery to that of its sale in England the total costs work out at 5d. per lb., leaving the balance of the price obtained to the original producer.

The call of the Mother Country for cotton, voiced by the Empire Cotton Growing Corporation on behalf of the industry in Britain, has been heard in Rhodesia and answered. The question of growing cotton in Rhodesia's country is no new one, but hitherto the demand for a market had awakened no response. As long as cotton could be got elsewhere of the kind wanted and at a satisfactory price, new supplies were not sought by the manufacturer. The Rhodesian farmer, on the other hand, could not be expected to and did not take up cotton until an attractive price and some prospect of permanency of market were assured. Maize had from the outset been his staple crop, but in spite of an effective co-operative selling organization and refinements of economy in production, handling, and transport, maize does not offer a very attractive reward for the labour and outlay entailed, and the Rhodesian farmer has been looking round for other crops to grow. The recently instituted propaganda in regard to Empire cotton growing has attracted his attention. Cotton, if it can be successfully grown, offers him not only a fair profit at present prices, but supplies him with a readily marketable crop in rotation with maize, whereas most other rotation crops have to be fed to stock before they can be converted into a saleable commodity, or have laboriously to be prepared for market as in the case of tobacco and maize. Cotton, too, can be converted into money, and just at the moment ready cash is very rare and much desired, so that it has caught public attention at a psychological and favourable time. Once packed and sent away, the farmer need do no more to his crop, the sphere of the ginnery and the ultimate destiny of the article being beyond his ken. For these reasons cotton is very welcome, and will be grown as long as it continues to return even a moderate profit, but production will cease as soon as the attraction disappears. Cotton has been made a promising success, on the modest scale indicated, by the unaided exertions of the Rhodesians. The potentialities of the country have been tested, the preliminary mistakes made and loss incurred by the farmers. The ginnery has been erected without outside help, on the strength of these prospects.

Rhodesians can claim to have done what they have by themselves alone and unassisted, and whilst proud of the fact, they would none the less appreciate some of the help and encouragement vouchsafed to other lands. The success achieved warrants the view that a much larger acreage will be planted next season, and that cotton will continue to be grown, probably with varying success, as long as markets and other conditions continue favourable.

This brings us to a consideration of future prospects, an aspect always accompanied by the risks of prophecy. Rhodesia seems to be standing to-day at the threshold of a new epoch—the era of cotton. The widespread desire to experiment, and the willing recognition of the experimental character of plantings in 1923, led to a general trial being given to cotton such as has never occurred in Rhodesia in respect of any other crop. This is fortunate. The year proved favourable for cotton. No district as yet can be condemned for cotton, although obviously some localities are more promising than others. During the next few years no doubt cotton will come to be recognized as worth growing in certain districts and not in others, just as is the case with any crops, and as long as prices leave the farmer a sufficient margin of profit for his capital, land, labour, and risks, cotton will be produced on a commercial scale. The official forecast for the acreage planted to cotton for the 1925 season is 60,000 acres.

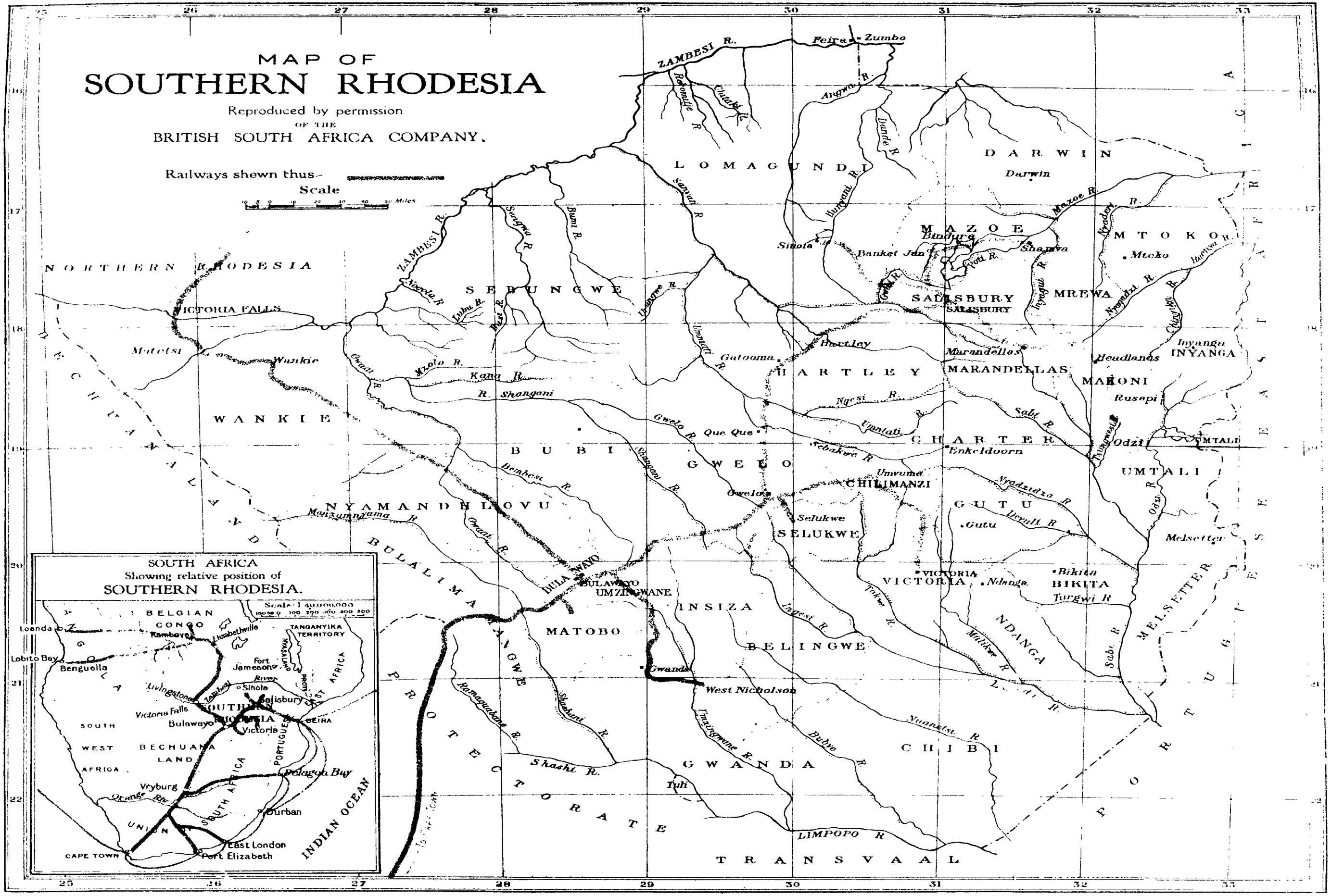
The European farmers are likely to be the chief producers of cotton in Southern Rhodesia, at any rate for some time to come. Native labour would largely be employed, as is to-day the case with all farm work. Possibly, when they have seen the success attained by the white men and have learnt from them how to raise and handle the crop, the natives may to some extent themselves take up cotton, but judging by experience in other directions, this is not likely to be done very largely nor immediately. The growth of the cotton industry would not seriously affect the native labour question, nor need there be apprehension of the converse. Cotton growing is likely to be developed by the arable farmers with their ordinary labour except at harvest time, when possibly natives, men, women, and children living on the farms or reserves, may find profitable piece-work for a limited time and working in large parties, all of which is congenial to them—so far as this can be said of any form of work.

Cotton will probably prove a valuable addition to our marketable crops, and instead of replacing other crops it is likely to lead, as a rotation crop, to an expansion of the area of cultivation of all crops.

A good local outlet for the crushed seed or the cake after extraction of oil can be assured for cattle fattening purposes. The oil will no doubt be utilized locally in place of present imports. As a rotation for maize, cotton will occupy a most important position in our farm routine. Cotton is likely, as elsewhere in the world, to afford a fair and safe return for a small outlay, and will therefore be a most welcome addition to the sources of income of many individual farmers, and in the aggregate to the country. Ginning should, in normal seasons, commence in Southern Rhodesia between May 15 and June 1. It should therefore be possible for a great part of the crop to reach the English market some months earlier than the new American crop, and so benefit by the high prices generally ruling in August and September.

There is little prospect of a local spinning industry, as the climate is unfavourable and the native population otherwise as fully occupied as they care to be. All lint will therefore be available for export.

There are a number of plants in the veld sufficiently nearly related in the botanical sense to cotton to ensure that as a crop it will not be free from insect pests. These comprise cutworms and leaf-eating caterpillars, aphis, cotton stainers, and other cotton bugs, and of bollworms, the American, the Sudan, and the spiny form, but most happily not the pink bollworm nor the boll-weevil. Stringent measures have been taken to safeguard the country from these evils. As cotton production increases in the territories to the north and east the danger of infection spreading into Rhodesia and the Union of South Africa becomes greater, and the utmost vigilance will be necessary to protect ourselves. The present Government entomologists and mycologist are competent to deal with the diseases



MAP OF SOUTHERN RHODESIA

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of cotton, to give advice in regard to combating them, and to conduct research into these subjects, and the present regulations in regard to importation of seed and lint are of a drastic character.

In the light of all these facts, it is noteworthy that at a time when one hears of so many schemes for raising money at home for cotton growing in the Union of South Africa and Brazil, few are found relating to Rhodesia. Perhaps this is not altogether a disadvantage, as it enables Rhodesians themselves to reap the full benefit of the position their own efforts have won, but in a young country there is always scope and a welcome for fresh enterprise of this sort.

Cotton is to-day only a subsidiary crop, the principal one being maize, which occupies four-fifths of the total area cultivated, and is of a quality not excelled in the world. Tobacco, too, of a very high class is largely grown, and citrus fruits largely exported to the English market. Other crops, mainly for local consumption, include wheat, oats, barley, millets, sorghums, rice, rye, and buckwheat, beans of many kinds, ground-nuts, potatoes, sweet potatoes, onions, sunflowers, cattle melons, pumpkins, etc., the list representing an extraordinarily wide medley drawn from the tropics and the temperate zones alike.

As a result of systematic experimentation a wide variety of crops have been proved to be suitable to Rhodesia, and the extent of cultivation depends chiefly upon the development of markets.

Irrigation is limited in its usefulness, since Rhodesia is not an arid country, but in view of the fact that it possesses, as well as a rainy season, a marked dry period in each year when all green food is scarce and when wheat and barley can be grown, the storage and use of water becomes most helpful alike to the arable farmer, the dairy farmer, and the cereal grower, whilst irrigation is absolutely essential for the successful cultivation of citrus fruit. In the lower and hotter regions, which are also those of least rainfall, there are prospects for large canals and big irrigation works for the cultivation of cotton, oranges, and perhaps tobacco and lucerne, whilst on the high plateau a small acreage under irrigation is a most valuable adjunct to almost every farm. Under our liberal and modern water laws there is every reason to expect a considerable development of irrigation in Southern Rhodesia during the next few years.

Progress in native agriculture is taking place, and there are possibilities for further advance in the future. Improvement in methods of handling cattle and dealing with indigenous crops amongst so conservative a people goes on slowly if at all. The main development consists in the imitation of the farming practice of the white man in those directions which are new to the native, the use of the plough and farm implements, the adoption of crops like wheat and vegetables. Cotton is likely to be taken up if and when Europeans have established it as a success and show the way—not otherwise.

Southern Rhodesia is primarily a wonderful grass country, the veld consisting chiefly of the *Gramineæ*, with certain *Leguminosæ* and a sprinkling of other species, whilst even under trees, whether occurring as savannah or dense forest, grass always covers the ground.

In these circumstances the pastoral industry is the dominant interest, and chiefly cattle farming on a wide and rather primitive scale, termed ranching, but also more intensive dairying, stud raising, and mixed arable and stock farming. There are two million head of cattle in the country, rather more than half being owned by Europeans, and the rest, of inferior quality, by natives. A burning question of the day is the best means of securing a market for the ever growing surplus of mature cattle, for without any adequate outlet they become a burden and a liability instead of an asset to their owners.

Geologically half the country consists of granite, 15 per cent belongs to Karoo formation, 11 per cent. is Kalahari rocks, but not necessarily, therefore, desert, over 8 per cent. is basement schists, or gold belt in miners' parlance, 6 per cent. is other sedimentary rocks, and the rest intrusive rocks. Southern Rhodesia is probably one of the highest mineralized countries in the world. Its precious wealth has long been known, for the remains of mining operations on a large scale are scattered widespread over the veld. These ancient workings appear as grass-filled hollows or pits and irregular hummocks, overgrown for centuries and easily overlooked by the uninitiated.

The minerals actually being worked for profit are a notable list, including gold, silver, lead, copper, chrome ore, tungsten ores, coal, asbestos, arsenic, tin, barytes, mica, corundum, diamond, ruby, sapphire, chrysoberyl, aquamarine, and topaz.

Gold is the chief mineral product of Southern Rhodesia, and one of the great attractions which first brought the white man to this country and still induces others to follow. Production is increasing, and recently there has been a notable expansion both in prospecting, in new discoveries, and in the number of mines commencing to crush ore.

Rhodesia ranks second in the world as a producer of asbestos, and is specially notable for the finer qualities of this mineral.

Arsenic is being exported on a large scale to the United States for the purpose of combating insect pests of cotton there.

Chromium is present in enormous quantities, capable of meeting the world's increasing need for this metal, as enormous surface deposits are known to exist which as yet are being worked on a comparatively small scale, although the traffic in chrome ore forms an important feature of the trade of the port of Beira.

National development must largely depend upon the political wisdom of the people. Prosperity depends upon the mining and agricultural industries. The progress of mining is dependent upon results being to-day attained by existing enterprises, since capital for new effort is attracted by their success. Commerce provides the needs of the prime producer and expands with his prosperity. The main body of the permanent population is provided by agriculture.

Rhodesia readily produces all the essential needs in the way of foodstuffs for its mining and urban population already, and further agricultural production must mainly be for export.

Owing to the distance from markets concentration of the products of the land into products of small bulk and relatively high value is essential; hence, our exports are likely to take the form principally of meat and meat products, including butter and cheese, hides, beef extract and tallow, also tobacco, cotton, grain, chiefly maize and meal and other derivatives, cereals, oil-seeds and oil, and citrus fruit.

From the very nature of the country large tracts are destined to remain as pastoral land, and only the more favoured localities are likely to be cut up so as to carry a more dense population devoted to arable farming. Temporarily the cattle industry is making no progress for lack of markets, and any inducement to progress is in abeyance, but that is only a passing phase. In all branches of agriculture there is great scope for individual and collective effort. Co-operation may be a great factor if rightly directed and limited to the legitimate field of production, leaving any attempt at industrial enterprise to the industrial section of the community, and avoiding interference with the liberty of the individual. It is that independent spirit of the pioneer farmer "facing alone the task of taming the wilderness and making the farm at the same time as making a living on the farm" which has brought agriculture in Rhodesia to its present pitch, and it is the exercise of these characteristics which is likely to enable the rich potentialities of Southern Rhodesia to be profitably and successfully developed in the future.

COTTON GROWING IN MADRAS

BY

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THE Madras Presidency, covering over 90 million acres, extends, as far as cotton is concerned, from 8° to 16° north latitude, and is thus well within the tropics. Its boundaries are, however, irregular through the inclusion of the large native states of Mysore, Cochin, and Travancore; and in configuration it is broken up by two ranges of mountains passing generally north and south. On the west, close to the coast, is the continuous rampart of the Western Ghauts from 4,000 to close on 9,000 feet high; and on the east the Eastern Ghauts, close to the coast in the north, gradually recede from it till they are lost in isolated masses about halfway down. This configuration makes the Presidency one of the most delightful parts of India from the scenic point of view.

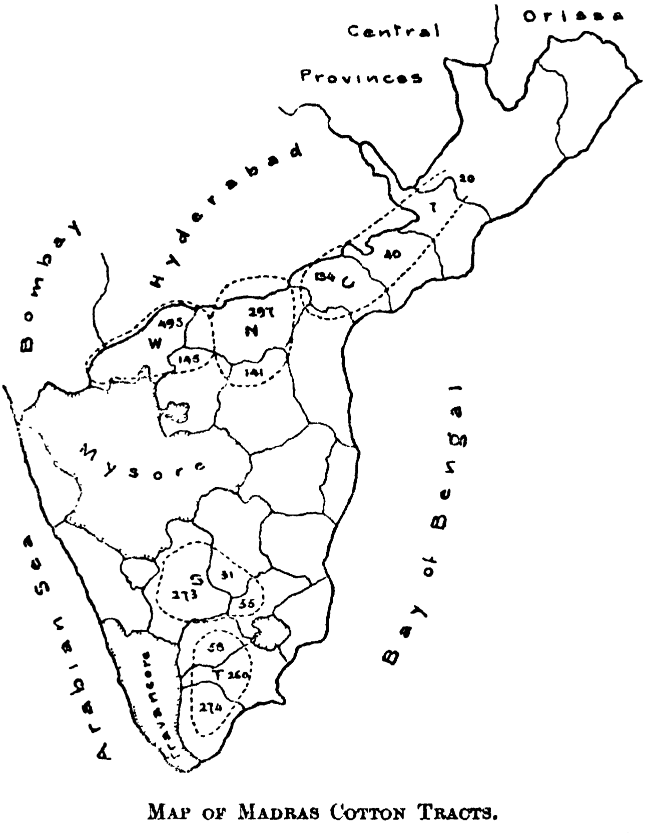
The indigenous cotton varieties are entirely rain-fed, and the annual fall in the cotton tracts roughly varies from 20 to 40 inches; this, considering the great heat of the tropical sun, is distinctly on the low side. As in all regions of periodic rains, the year is divided into " wet " and " dry " periods. The bulk of the rain falls between May and November, and it is not infrequent for the remainder of the year, December to April, to suffer from a spell of continuous drought for five consecutive months. The growing period for cotton is therefore somewhat strictly limited, and there are other factors which prevent the full rainy period from being completely utilized for this crop. In these conditions it is only possible to mature the crop because of the presence of a peculiar type of soil, specially fitted in all respects for the growth of the indigenous types. This is termed locally the " black cotton soil," and a brief description of it will be necessary in order to understand the Madras conditions.

This soil covers large areas between the mountain ranges, either in great plains or on slightly undulating land, and is intensely black in colour. It is not met with in northern India, but covers immense areas slightly on the western side of the main axis of the peninsula. Its origin is rather mysterious, but the northern portion (Bombay, etc.) appears to have been derived from the trap formation, and the southern (Madras) from the prevailing gneiss. It is very uniform in texture, so as to show little difference between soil and subsoil, and remarkably retentive of moisture. It cracks deeply during the dry part of the year, but readily breaks down to a fine powdery mulch, especially under repeated shallow cultivation. The Madras black cotton soil is said to be rather poorer than that derived from the trap, is often slightly saline, and generally underlain by a layer of limestone concretions known as "kankar," which provides an excellent road material. The indigenous Indian cottons are distinctly deep rooting, and so possess a considerable degree of drought resistance; they can thus, on this soil, go on growing and mature their bolls long after the last rains of the year have fallen. Lastly, the black cotton soil is markedly free from weeds of cultivation, and only a few kinds of trees are met with on it; so that the larger cotton areas present, during the off season, the appearance of boundless black desert plains, without the clumps of trees and scattered villages so characteristic of southern India. Weeding costs are greatly reduced, a surface mulch is rendered easy, and we have here a fine example of dry farming, evolved by the cultivators in their ancient indigenous agricultural system.

Another factor of extreme importance which must be further discussed before we can form an opinion as to the Madras cotton conditions is the length of the growing period. In North India cotton is grown as a summer crop because of the winter cold; in the south of Madras it is a winter crop; and in the northern part of Madras a transition between these two extremes is met with. In the Madras Presidency cold is no longer a factor of importance: the incidence and duration of the rains dominate the position. The rainfall in the northern part, commencing in May, makes it possible to plant the crop during July and August, whereas in the extreme south it is necessary to wait till October. In both cases, because of the absence of rain after December, picking begins in February, and this leaves very little time in the south for cotton to grow. India is noted throughout the world for its short growing period for cotton, and this is shorter in the south of Madras than elsewhere in India with the exception of the extreme north-west. Nothing but the retentive nature of the black cotton soil, the drought-resistant character of the Indian species, and the intelligent labour of the ryot could enable the crop to survive.

On the average there are in Madras over 2,300,000 acres grown under cotton each year. There are five main tracts distinguishable, primarily dependent on the distribution of the black cotton soil, but also separated by the trade into time-honoured grades of lint. The arrangement of these is shown on the accompanying map. In the northern section, adjoining similar areas in Bombay and Hyderabad, a broad band extends from east to west and is divided into three tracts, termed Westerns, Northerns, and Coconadas respectively, diminishing in acreage, the first two together covering over 1,000,000 acres and the last under 250,000. The species of cotton grown are, in the Westerns tract, almost pure *Gossypium herbaceum*, with a rather short, harsh lint of a pure white colour; in the Northerns, *G. herbaceum* with a considerable admixture of *G. indicum*, with a lint as a rule less white in colour but of distinctly superior length and softness; and in the Coconadas tract, which is less clearly defined in area, but has its focus near to the Northerns and extends in a north-eastern direction, an entirely new species is grown, named *G. obtusifolium*, with soft lint, often of a distinct khaki colour, irregular in length, and inferior in staple to Northerns. In the southern part of the Presidency there are two main tracts, known as Salems and Tinnevellies. The former is again less clearly defined, having its focus in the extreme west (Coimbatore) and extending in a south-easterly direction, while the latter forms a compact area in the extreme south of the Presidency. These two areas comprise 360,000 and 660,000 acres respectively; the predominating species is *G. herbaceum*, but towards the south *G. indicum* comes in till, in the extreme south, it is the species almost exclusively grown. The lint varies with the species as in the northern region, but is, on the whole, of a better class. Included in the acreage of the southern tract, there is a newly introduced American species (*G. hirsutum*) grown under special conditions which will be referred to later.

Coupled with and dependent on the geographical distribution of these cotton tracts in Madras, there are marked differences in elevation and climate. In the northern half we have the highest and driest cultivated land in the Presidency. In the heart of the Westerns tract, which has an elevation of from 2,000 to 3,000 feet above sea-level, less than 20 inches of rain fall on the average during the year, which means that in alternate years the total is less or more than this. Extreme dry heat is experienced during the early summer (April to June), while during the rest of the year the air is pleasantly cool. Much of the Coconadas tract lies little above sea-level, and the rainfall averages 40 inches; the weather, although often hot and steamy, has none of the great heat further west. The Northerns area, although broken up by ranges of hills, lies between



Map of Madras Cotton Tracts.

The outlines of the Madras Presidency are thickened. Native States are surrounded by dotted lines, the chief of them being Mysore and Travancore. Broken lines are drawn around the five cotton tracts: W, Westerns; N, Northerns; C, Coconadas; S, Salems; T, Tinnevellies. The figures indicate thousands of acres in various districts within each tract.

the two in these respects, with a rainfall a little over 30 inches. Similar differences are met with in the southern region. The elevation is about 1,200 feet in the west of the Salems tract and sinks in a south-easterly direction to near sea-level, the rainfall increasing from about 22 to 30 inches or more. Most of the Tinnevellies tract is little above sea-level, and the rainfall is about 28 inches. The weather in the south is more insular in character, and, while there is a short cool season at Coimbatore, the rest of the tract is uniformly hot, but the heat of summer is less intense than further north.

Cotton cultivation in Madras is of a high order, but, as the cotton tracts are occupied by three different races, there are variations, sometimes of a substantial character. In all alike, as elsewhere in India, the " plough " is merely a heavy cultivator, and there is no attempt to turn the sod; indeed, such a thing as a sod is practically unknown. There is little difference between soil and subsoil, and this shallow cultivating action of the plough is not so primitive as would appear, when we consider that the conservation of moisture is the main aim in all field cultivation in this hot, dry country. In the Westerns and Northerns tracts and in the main portion of the Coconadas the cultivation of the Canarese and Telugus is often very good; and its chief distinction from that in the southern area is that the crops are drill-sown. The drill itself, a contraption of bamboos and ropes and bits of wood and iron, is, according to competent agriculturists, one of the most efficient and economical in the world; and the sowing in lines has given rise to a whole series of cultivators, harrows, and hoes, of very light draught, which can be run over a number of rows of the crop at the same time. Three-tyne implements are the rule, but they vary from one to twelve, all except the latter being easily drawn by a single pair of bullocks, and they are much simpler than the drill in structure, being made for a few shillings by the village carpenter and blacksmith.

In the south of Madras the Tamils are noted for their agricultural efficiency, and this is well seen in the cotton cultivation in the Tinnevellies tract, although some very good work can be seen in the western focus of the Salems. But the drill is unknown to the Tamils, the seed being broadcast or dropped in the plough furrows; and this difference carries with it a world of others, the details of which cannot be even touched upon here. In place of the multitude of special implements in vogue in the northern region, the indigenous plough and hoe, with the right men behind them, are fully capable of dealing with all the needs of the crop.

The preparation of the ground is very carefully attended to, for the cultivators are well acquainted with the necessity of a perfect seed bed for germination and early growth. Cotton seedlings, because of their long tap root and large ear-like cotyledons, are specially liable to injury before the root branches, and foliage leaves appear. No manure is, however, given to the crop, because experience has taught the ryot that the rank growth thus induced during the warm, moist growing period would prevent the bolls from ripening before the hot, dry early summer, when all immature flowers and bolls are quickly shed. Any manure that has been got together—cattle droppings, ashes, domestic rubbish, and crop residues—is given to the previous crop of the rotation; and this manure being of a slow-acting nature, while the rotation crop is a short one, much of it remains over unutilized.

Except in the case of poor farmers who, for financial reasons, are compelled to sow their cotton year after year, rotation is universally practised in Madras cotton cultivation; and the general selection of a cereal crop for this purpose is agriculturally sound. The cereal, besides being only for a short time in the ground, is shallow-rooted, and contrasts well with the deep-rooting cotton in its soil demands. The kind of cereal varies with the locality; but it is usually some form of millet, the staple rain-fed grain crop of the tropics of the Old World; the great millet (*Sorghum*), Italian millet (*Setaria*), and spiked millet (*Pennisetum*) are the most important as regards rotation with cotton. Leguminous plants often enter the cotton fields, but this is more the case in the drill-sown tract; cotton is usually sown pure in the south.

Weeding, as already noted, is not a serious item, at any rate in the later stages of growth, but the land is continuously worked over after the rains have ceased, until the desired fine mulch of the black cotton soil is obtained, when the fields may be safely left for the maturing of the crop. Picking is not such a difficulty in India as elsewhere, and is usually done by gangs of women and children. It is, however, very badly done in the northern tracts, and, after close study, it has been found very difficult to see how this can be altered, for the following reasons: In the Indian climate, where the sun becomes very hot soon after rising, it is most desirable that the cotton should be picked while the leaves and bracts are still pliable after the night's dew; for if this be neglected it is almost impossible for the pickers not to break off small bits when pulling the lint out of the bolls. According to the economic arrangements in the northern villages, picking falls to the lot of the women; these are quicker and better pickers than the men, and so have complete charge of the situation. As they have first to attend to the preparation and cooking of the day's food, they are unable to enter the fields until the sun is well up, and the cotton suffers in consequence. The difficulty, moreover, appears to be a local one; the pickers spend the day in the field and rely mainly on the evening meal, while in other parts the midday meal is the rule.

The marketing of the cotton leaves much to be desired, although improvements are being gradually introduced by the Agricultural Department in co-operation with the larger cultivators and merchants, and with the Indian Central Cotton Committee, which is devoting special attention to the prevention of the mixture of inferior cottons with good kinds that goes on so largely, and damages the reputation of the latter. The poorer cultivators—who constitute the bulk of the growers—always in need of money, are more or less in the hands of middlemen and moneylenders, both functions being often performed by the same individual. Without external help, it is thus idle to expect the ryots to make any change in their time-honoured customs, although they may be very well aware that they do not receive the full value of their produce. The explanation of the anomaly is, however, fairly simple, in that mixing of inferior lint is a well-established practice in most parts of India, the idea being to do this so circumspectly that it will either not be noticed and the value of a superior kind obtained, or that the fine imposed will not be large enough to equal the gain obtained by this fraudulent practice. The introduction of co-operative selling, the establishment of regular buying markets, and the formation of buyers' associations, which would remedy these defects, are not easy matters, because of the vested interests involved. And there is always the fact that the local middleman will go from door to door and pay cash down, knowing that the poor grower often cannot afford to wait, even if he be free to sell where he likes—which is not often the case. But improvements are gradually making headway, especially in those areas where new and better kinds of cotton have gained a definite status on the Liverpool market. In general, the local practice of judging the value of the cotton by its place of origin, using past experience for thus classifying it, makes it almost impossible for any improvement to be made in quality, unless this is done on a large scale by co-operation.

A considerable amount of research work has been devoted to cotton in Madras since the formation of the Agricultural Department about twenty years ago; and in various directions marked success has been obtained in improving the character of the lint. The problem is, however, a different one in each tract, and a description of the way in which favourable results have been obtained would necessitate a much longer article than the present. Good work has been done in both the Westerns and Northerns tracts in selection among the indigenous varieties, but it is in the Tinnevellies that the most outstanding success has been obtained, after years of patient separation in the fields, mass selection, and selection along progeny lines; and, when a good strain has been evolved, by introducing co-operative growing and selling among the larger cultivators and influencing the firms buying the cotton. The net result of this work, started in 1905, is that at the present time there is a grade of superior cotton sometimes known as "Tinnevelly American," but better as "Pure Karunganni," which is well known and appreciated on the Liverpool market. The length of lint is $\frac{9}{10}$ to 1 inch, and the ginning percentage 25 to 26, as against $\frac{3}{4}$ to $\frac{7}{8}$ inch and 27 for ordinary Tinnevellies.

A further success has been obtained along an entirely different line—that of the introduction of a form of American Uplands, first grown in Tinnevelly, but reaching its greatest development in the western focus of the Salems, round Coimbatore. The Uplands type of cotton has not the deep-rooting system of the indigenous Indian species, and does not, therefore, succeed in growing on the exiguous rainfall and in the black cotton soil; but, with occasional irrigation from wells, in land of lighter texture and colour devoted to the intensive growth of food grains and vegetables—land that is well manured and carefully cultivated—this cotton, called after its place of origin "Cambodia," has spread right over the southern part of Madras. The length of lint of this type is a little over 1 inch, and the ginning percentage 33, and it fetches a price equal to or slightly higher than ordinary Uplands cotton.

THE WEIGHTS AND MEASURES OF THE COTTON HAIR*

BY

W. LAWRENCE BALLS, Sc.D., F.R.S.

SCIENCE was once defined by Huxley as " organized commonsense " —a very good definition so far as it goes. If we desire to exercise our commonsense on cotton, it is well to begin by a clear conception of the facts that are to be marshalled into order. Most students of cotton have now got into the habit of considering it as an aggregate of single hairs; but it has been my own experience that the familiar elementary measurements of the shape and size and weight of cotton hairs became quite startling when used to construct a scale model of a single hair. So it seemed to me that some very dull facts might usefully be presented once more, if the presentation were done in such a way as to link up with matters of everyday experience and so help us to use " organized commonsense " in dealing with cotton problems.

We will begin by looking at the hair in terms of the crop from which it comes; then at its size and shape and the size of its component parts, in relation to the yarn made from it and in relation to some common objects of everyday life. Finally, we shall find that we have a scale by which to measure the dimensions of our own ignorance of cotton. We shall keep to round numbers and first approximations, in order to avoid too many figures in a row, which are as annoying as Randolph Churchill's famous " dots."

The Hair and the Crop.—The figures might be too impressive if we considered the American crop, so we will take instead the relatively small Egyptian one. And we will assume the Egyptian crop to be five million kantars, grown on an area of rather more than one million acres and worth fifty million pounds sterling. What share has one cotton plant—not to mention one hair—in this proposition ?

The principal figures for our calculation are as follows: One boll contains about two grams of seed cotton or two-thirds of a gram of lint. Therefore, since there are fifteen bolls on a plant, the single average plant produces a crop the weight of which is about ten grams, or one-third of an ounce, worth a halfpenny. An acre produces five kantars, or about two hundred and twenty-five kilos from twenty-five thousand plants.[1]

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* **Based on a lecture to the Bollington Mutual Cotton Class, October 14, 1924.**

Now this contribution by our single plant may sound very trivial; but if it is a pretty fair kind of Egyptian cotton (such as Sakel) it will spin into 120's, and so will give us—after due allowance for waste—just a measured mile of singles yarn, which would keep a mule spindle running for about a day. So one plant, one spindle, one day, is a convenient mnemonic for the fine spinner.

But as yet we have not got to grips with the cotton unit, the hair itself; and to do so we want three more figures: the number of seeds to the boll, which is somewhere about twenty; the weight of a seed, which is one-tenth of a gram; and the number of hairs per seed, which is rather below than above ten thousand.[2,3,4] Thus there are nearly three million hairs in this miniature crop from one plant. Otherwise stated, forty to fifty hairs are added to make every inch of yarn in that mile-long crop.

It is not very long ago that I started the idea that a crop should be studied as if it were really a large number of single plants[5]; and, in cotton growing at any rate, we have got away from our previous attitude—that a crop was a crop but a plant was only a plant—and knowledge is increasing in consequence. This plan of splitting down to the smallest unit worked so well that I tried it on the cotton itself, scrapped the old, technically incorrect expression, "the cotton fibre," re-christened my units by the correct title of "cotton hair," and proceeded to think about spinning problems in terms of these individual hairs, which are the natural unit for the spinner and microscopist just as the plant is for the agriculturist. Calculating from the figures already given, but this time by number instead of by weight, we find that one cotton hair is $\frac{1}{75.000.000.000.000.000}$ or $1{\cdot}3 \times 10^{-17}$ of the Egyptian crop, which is about the same proportion that one man would bear to a crowd consisting, not merely of the whole population of our Earth, but of forty-five million Earths of similar population. Yet it is in terms of such insignificant units that we must formulate our cotton problems.

The Hair and its Structures.—We can dismiss the hair structures quite briefly, as a previous lecture[6] described the growth rings and spiral fibrils in such detail as was then possible. We need only to note down two approximate figures, for the thickness of a growth ring and the width of a fibril; but in order to do so we must stop to consider our scale of measurement. For reasons shortly to be evident, inches, or even—in workshop jargon—"thous" of an inch, would be too cumbersome. We will use instead the microscopist's unit of measurement, which is one-thousandth of a millimetre, called a "micron" or "1μ"; why this should be convenient for microscopy will also be self-evident later. Since one inch is 25·4 millimetres, one "thou" is 25·4μ. Now a growth ring averages 0·3μ in thickness and a fibril 1μ in width. How do these fit into the scheme of things?

Some two-fold 60's yarn is shown in side view (Fig. 1) and in section (Fig. 2). Being 2/60's, it weighs one lb. at a length of $\frac{60}{2} \times 840$ yards. This equals about two million centimetres; so that (1 lb. = 453,592 mgs.) one centimetre weighs approximately 0·2 milligram. Having turned the spinner's cumbersome "count" into the convenient form of weight per centimetre, we can start playing with figures again, and find at once how many hairs there are in cross-section of this yarn; because the hair weight per centimetre of the Sakel cotton from which it was spun was about 0·00151 mg., or $\frac{1}{133}$ of the doubled yarn weight for the same length. Thus, each of the two single ends of yarn in this section of the two-fold contains (on the average of all the yarn) about sixty-six hairs. The usefulness of this hair weight figure is very evident; and as it not only gives numerical expression to the chief factor in the term "fineness," but is also easy to measure quickly and accurately, I am rather proud of having introduced it to industrial research.[7,8]

Next let us use this figure to get an idea of the difference between various kinds of cotton. Small differences, such as are important in any one mill, do not interest us for the moment. We will straddle the whole range of commercial cottons, so far as they have been examined in our testing laboratory, and pick out the two extreme types—viz., Dr. S. C. Harland's pure line Sea Island V.135[9] as the finest and some Burma Wagyi as the coarsest. Between them we will put one good "bread and cheese" Brown Egyptian as a happy medium for comparison, and so draw a diagram (Fig. 3) in which the cross-sections of these three kinds of cotton hairs are represented in correct relative scale. Before considering this diagram, however, we must notice that each of these three cross-sections represents the average for all the hairs of its kind; we shall return later to the difference from hair to hair within one kind.

The approximate hair weights per centimetre of these three cottons were respectively 9, 16, and 36, if we take as our unit (to avoid dots) a weight of one ten-thousandth of a milligram. At first sight this seems erroneous, for one would imagine that the greatest difference between "coarseness" and "fineness" would be much more than this. Nevertheless, these are the limit figures which we possess. Now these numbers stand, not only for the ratios of the weights, but also for the ratios of the areas of the cross-sections—provided, that is, that the density of the spongy cell wall is constant,

FIG. 1.

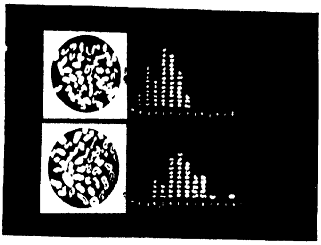

FIG. 5.

FIG. 4.

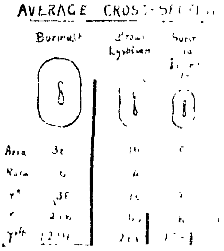

FIG. 3.

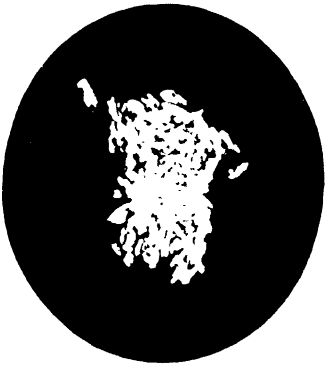

FIG. 2.

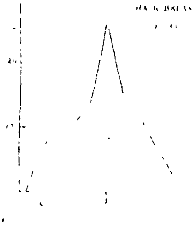

FIG. 6.

which is another and more elaborate story. The ratio of the diameters of these areas will follow the square root of these numbers—viz., 3, 4, and 6. Thus the microscope is not as useful as might be imagined in recognizing different cottons, since the coarsest is no more than twice the diameter of the finest.

Let us now start from these diameter ratios (3, 4, and 6) and go back to their squares (9; 16; 36), then on to their cubes or third powers (27; 64; 216), and to their fourth powers (81; 256; 1,296). Naturally the differences increase; so that in the fourth power we have sixteen times as high a figure for the coarsest cotton as for the finest.

This may look like futile juggling with numbers. But actually it is the essence of cotton spinning; because the force which resists deformation of a rod (whether in a cotton hair or the steering column of a Ford car) varies with the fourth power of the radius. Bending as well as twisting is largely governed by this fourth power also, though in neither case is it feasible to use mathematics too rigidly with cotton on account of the peculiar form of the hair. But my former colleague, Prof. F. P. Slater, in a series of extremely delicate experiments, showed that the rule was correct in outline at least. Our Burma cotton is thus nearly sixteen times as " coarse " as the Super Sea Island (as shown by the heavy upright lines in Fig. 3); and this is just about the real practical difference. Incidentally, this adds another curiosity to our translations of spinners' terms; we have known for some years that " strong cotton " means weak hairs (if it does not mean slippery ones), and that strong hairs make weak yarn; and now we see that " coarseness " really means stiffness and not merely thickness.[10]

Before leaving the average hair we may, with advantage, examine a rough model of a hair made by sucking the air from a length of rubber tubing, but choosing the length in correct scale to the " ribbon width " of the collapsed tube. Since the actual ribbon widths of the hairs in our three cottons were 15·4μ, 19·4μ, and 27·1μ, we can take 20 as a typical figure. The length of the hair may exceed sixty millimetres in Harland's V. 135; but we could not find a stretch of tubing long enough to simulate this when the photograph (Fig. 4) was taken. The collapsed tube had a ribbon width of half an inch; so that although it was sixty feet long it only represents an ordinary American hair of 1⅛ inch staple! The importance of flexibility in cotton is very obvious when such a model shows us what a long thin thing is the single hair. In a previous lecture[6] I said that if all the fibrils in one ounce of cotton could be extracted and put end to end we could girdle the earth more than five times. Since there are about 3,000 fibrils in one such hair as that represented by our model, each rather longer than the hair itself, the statement now seems quite modest.

Some Comparisons of Size.—Having visualized the real proportions of the hair and stated its dimensions in milligrams and microns, we may usefully compare its size with that of a few common objects. A pin's head is a proverbial dimension; and taking a small pin at random, I find its head to be eighty-thousandths of an inch across, while the diameter of its shank is thirty-four. The paper used for the cover of the *Empire Cotton Growing Review* is eleven, while that used for the pages is six; typewriter flimsy paper is three, and cigarette paper gives a rough definition of one-thousandth of an inch, or 0·001 inch.

Cigarette paper is thus about 25μ thick; and this is about the ribbon width of our coarsest cotton, while the same measurement in our finest cotton is just over 15μ. The other " diameter " of the hair is equal to twice the thickness of the cell wall; and this wall thickness is about 10μ in the coarse cotton and only just over 5μ in the fine one. Now this last dimension has an engineering interest; for although it is only one-fifth of the thickness of cigarette paper, it is the limit to which ball-bearings are classified by gauging after manufacture[15]—viz., two ten-thousandths.

We now pass to the fibrils, which are about a micron in width, and so get beyond the limit of microscopic vision before arriving at the growth rings whose average thickness is about 0·3μ, though the variations are great. At this stage the micron is too big a unit for convenience; and instead of measuring in thousandths of a millimetre—*i.e.*, microns—we shift our base to ten-thousandths $(\frac{1\mu}{10{,}000})$ of a micron; this is the physicist's Angström Unit, written as A.U. or cm.$\times 10^{-8}$, whereas the Micron is merely cm.$\times 10^{-4}$.

In reaching the growth ring of 3,000 A.U. thickness or less, we passed another landmark at the wavelength of yellow light from sodium vapour, which is 5,896 A.U. There is only one object of everyday life comparable with the growth ring in thinness, to wit—gold-leaf; this is notoriously tenuous, but it is somewhat surprising to find that the text-books give its thickness as 2,000 to 800 A.U. It is perhaps a helpful comparison, since it enables us to visualize the solid reality of these invisible growth rings.

We now reach a temporary barrier which is being slowly demolished by research. The space occupied by an atom has been measured with accuracy in various substances; and we can take some such figure as 2 A.U. to represent the distance between the atoms (carbon, hydrogen, and oxygen) which make up the cellulose substance of the cell wall (in the diamond it is 1·52 A.U.), but as yet we cannot ascribe any intermediate dimensions. Thus we measure the magnitude of our ignorance of cotton; for, as the growth ring is one-thousandth of the thickness of two pages from the *Empire Cotton Growing Review*, so the atom is one-thousandth of the growth ring. Moreover, when we reach atomic magnitudes there is still another world of scientific exploration to traverse, till the electron and proton are reached, to which are ascribed diameters of $1{\cdot}85 \times 10^{-5}$ A.U.

What we shall find in the cotton hair as we crawl or jump down this gap in the ladder of magnitudes, between 3,000 A.U. and 2 A.U., is as yet matter for speculation only. Probably the next important dimensions will be those of a long tadpole-like structure, lying neatly head to tail with its fellows, itself an aggregate of molecules of cellulose,[16] these in their turn being geometrically patterned with atoms.[17]

Variations of Size within a Single Kind of Cotton.—I used my previous lecture[6] to direct attention to the impossibility of ever growing a ready-made sample of " uniform " cotton. Much of what has been said and written (by myself as well as others) on the importance of uniformity has been mere repetition of traditional assertions; and some of these assertions have been disproved by the test of experiment. Nevertheless, there remains one character whereof we may be certain that greater uniformity would be advantageous—namely, " fineness "; this means, as we have seen, hair weight per centimetre, or sectional area, or flexibility. Moreover it is probably the character over which the plant breeder and farmer have the least chance of control. How tremendously variable it is from hair to hair, how small a change in it is needed to alter the cotton completely, and what immense possibilities await the invention of a machine which will classify for fineness (just as my Sorter[11, 12] classifies for length), can be seen from the following example.

Our laboratories had found Harland's V. 135 exceptionally uniform in all the hair characters which we had examined. Consequently we were much interested when Mr. R. E. Massey sent us a sample of this strain which he had grown near Khartoum, along with other Sea Islands under trial. Now, considered as Sea Island cotton these samples were a failure; they might have mixed successfully with wool, but they were too harsh and wiry for most cotton machines adapted to their long staple. Out of curiosity we measured the Sudan V. 135 against material grown in St. Vincent, and found the hair weight per centimetre 50 per cent. higher in the Sudan sample; in terms of the fourth power relationship, this means that the Sudan hair was more than twice as stiff as the St. Vincent. As the difference was so very large we cut sections of the hairs to find their approximate area, and so to see whether there were any striking differences in density. Actually there were none; but as Mr. Hancock had prepared and drawn these sections and cut out the drawings for purposes of measurement, we thought it would be interesting to ascertain the area of each section separately, and so classify the hairs by size in a frequency diagram, using the actual section drawings instead of imaginary points (Fig. 5). Considering this figure, we see in the first place a very neat example of what the statistician means by a "frequency diagram." Further, we demonstrate the effect of two different climates upon one and the same pure line of cotton seed. Also we show the variability from hair to hair in both places to be of similar magnitude. It is evident that the Sudanese sample will not make any "nep," since none of its hairs are thin enough to curl themselves up irrevocably;[13] in the St. Vincent grown sample, on the other hand, we can see at a glance where the nep will come from.

But the feature to which I would especially direct your attention is the scale of areas for each class. In the St. Vincent sample the smallest class (*i.e.*, column of the frequency diagram) has an average area of 5 arbitrary units, while successive classes go by steps of 5 up to a 35-unit class. In this last there are no less than three hairs out of the total fifty. The Sudan sample has one hair whose area is so great as 60 units. Now, remembering that area and weight have the same ratio, let us recall the numbers we used to straddle all the commercial cottons of the world. Burma Wagyi was 36, Brown Egyptian was 16, and V. 135 itself was 9. But here, within one sample of an exceptionally uniform cotton (the best cotton in existence to-day, a pure line stock grown on an experiment station), we find a bigger range within fifty random hairs than the whole world can give us when we use the "average hair." Instead of 36 to 9 we have 35 to 5. As a demonstration of the huge residue of unavoidable irregularity in cotton as it leaves the farmer, we could hardly have anything more striking. It is "up to" the spinner who uses the cotton to deal with this; neither Providence nor the botanist can help him further than the half-way house towards his desired uniformity.

When the Hair Breaks.—To conclude with a glance at the ultimate purpose of the cotton, which is primarily the production of something which gives such a combination of strength and flexibility as no other material can provide.

The strength of yarn is an intriguing puzzle; about three-quarters of the puzzle we can solve, but not much more. One of the disadvantages of accumulating too much information is that the hundredth exception turns up after a year or so—and it does not prove the rule in science, however much that misinterpreted proverb may be quoted. Still,* the starting-point for yarn strength is hair strength, which fixes the upper limit to what the yarn can carry, or, as I term it, the " intrinsic strength " of the yarn. But we must avoid confusion between yarn strength and hair strength. At any given count of yarn the total Weight of Cotton per centimetre is defined; the number of hairs can vary; and the more there are (*i.e.*, the lighter the hairs) the more regular will the yarn be and the lower the twist it will need. So that the lighter and weaker the hair, the stronger the yarn. But two sets of hairs may have the same Hair Weight (thus giving the same number of hairs in yarn section) and yet differ in Breaking Load; here we have another factor to consider, the Break per Equal Weight,[8] and this varies over a fairly wide range. It is low in the Indian cottons and highest in the Sea Island. Part of the variation is a direct physical consequence[14] of cross-section differences, but part seems to be due to hair-structure differences. The ratio as between our Burma, Egyptian, and Sea Island samples in this respect is approximately 6 : 12 : 16.

It is self-evident that, other things being equal, the strength of a hair will depend on how much of it there is—*i.e.*, on its cross-section. We may, therefore, expect similar variation in strength from hair to hair to that which we have just seen in cross-section; further reflection will indicate, and correctly, that the variation should be even greater, since additional variables have to be considered. In Fig. 6 we have the frequency diagram for Hair Break under dead load in a typical sample of Egyptian Sakel, made on my automatic Magazine Hair Break Tester. On the diagram is photographed a shilling piece, because the average breaking load of one hair is just about the weight of a shilling, being between 5 and 6 grams. If we look back (Fig. 3) we shall find that the actual sectional area for Egyptian is about 300 square microns; reduce this by about one-third to allow for submicroscopic air spaces in the spongy cell wall,[6] and from this work out the breaking load in tons per square inch. We find it is about 20 tons per square inch for V. 135 and ranges down to about 8 tons for Burma Wagyi. Thus our fragile, spongy, plastic cotton hairs are, at their best, not very far behind mild steel as load carriers, and the worst of them is about equal to copper.

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* In [1], (p. 146) I restated the available information derived from previous writers and from spinners' opinions. It is now evident that most of this information was merely tentative and unreliable; unfortunately, subsequent writers regularly quote this restatement as if it were an original opinion; at the time it was written I had no experimental knowledge of yarn, and therefore believed what the experts told me about it !

We are only just beginning to find out why cotton yarns are so strong; and when we do know why we shall most likely be able to make them stronger, and also to make artificial silk that can compete with cotton. Since artificial silks can be made from many cellulose raw materials, and since cellulose will be available so long as there are higher plants in the world, they are bound to have the economic advantage[18] over cotton with its specialized origin, unless cotton specializes its use also. The history of artificial silk has scarcely begun, and it will be a very interesting one.

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COTTON GRADING

THIS subject is of such great importance that the appearance of the three articles that follow will doubtless be welcomed by all.

A. GRADING OF COTTON IN THE SUDAN.

All cotton grown under the Gezira scheme is graded by officials of the Sudan Plantations Syndicate at their ginning factories. These officials are usually Greeks or Egyptians who have been trained by leading cotton exporting firms in Egypt. Later on it is proposed to train Sudanese for the work. The rates of pay are according to capabilities of the men employed, and are generally somewhat higher than those ruling in Egypt for similar work, housing and return fares to Egypt being additional expenses. A man can sample about 800 bales a day. The cost of the operation is shared by the partners in the ownership of the cotton. The packing of these bales of seed cotton is done by the tenant at his house situated alongside his cultivation, and each bale weighs approximately 400 lbs. If his cultivation is situated comparatively near to the factory the bales are transported by camel direct, but failing this the cotton is sent by camel to one of the collecting stations and is consigned from there by train to the factory. Each bale bears the tenant's name and his number, and on arrival at the factory is weighed and graded. All the cotton is graded before ginning, the operator making a small slit in the cotton pack from which he draws a sample. The cotton pack itself weighs from 3 to 3½ lbs., and can sometimes be used to make two journeys.

B. COTTON GRADING IN SOUTH AFRICA.

BY

TH. G. HESSE,

Government Cotton Grader.

The cotton industry in the Union of South Africa is, comparatively speaking, young, and its introduction, fostering, and guidance has been mainly in the hands of a small expert staff under the Chief of the Tobacco and Cotton Division, Department of Agriculture.

At a very early stage in the development of the industry the Government decided to enlarge the field of its activity by adding a service for grading and marketing the crop. It was felt that farmers could not fairly be encouraged to grow cotton unless reasonable marketing facilities were at their disposal. The aim was to establish from the outset methods of orderly marketing which would avoid the wastage and uneconomical methods observable in most older cotton-producing areas. The most important step was to provide for grading facilities, as no orderly marketing is conceivable without grading in the country of origin. Thus, beginning with the season 1920-21, the Government undertook the grading of cotton on a voluntary basis—*i.e.*, any party could call for the service of the Government cotton grader. Up to that season there was no grading, except by the South African Co-operative Cotton Growers, Ltd., in conjunction with the Agricultural Co-operative Union at Durban, but only as far as their own cotton was concerned.

The facilities offered by the Government were evidently appreciated by ginners and farmers, as 65 per cent. of the cotton exported was graded. It was felt, however, that to obtain the best results and to firmly establish South African cotton on the world's markets, all cotton exported should be graded, and consequently grading was made compulsory by proclamation of April 16, 1923, and the crop of 1922-23 was handled and graded accordingly.

PRELIMINARY CLASSIFICATION OF SEED COTTON.

In the early days serious complaints had been received from overseas regarding mixed packing and lack of uniformity in shipments. In order to check the damaging features of mixed packing, preliminary classification of seed cotton at central or public ginneries was undertaken. At these ginneries seed cotton is collected in woolpacks of from 400 to 500 lbs. to be gradually ginned. This cotton may come from all parts of the country, is the product of many farms, and represents all grades and staples. It would be fatal to gin pell-mell, and therefore a method of classification imposes itself in order to ensure that only cotton of one style be ginned together. This classification must take into consideration, and the cotton be grouped for ginning according to—

1. Staple. 2. Cleanliness. 3. Colour.

The woolpacks are suitably marked in accordance with the classification, and ginning then proceeds, only woolpacks carrying the same marks and as far as possible from one grower being ginned together. In order to overcome the slight variation from woolpack to woolpack, observable even when the cotton comes from one grower, three or more packs are fed to the gins at a time, thus averaging the cotton and obtaining the best possible uniformity.

SAMPLING.

The regulations promulgated in consequence of the establishment of grading as a compulsory measure provide that samples be taken as follows:

" One portion from the cotton lint filling the bottom of the press-box, another portion when the press-box is half full, and a third from the top layers of the press-box. The three portions together should weigh about ½ lb., and must be laid one on top of the other and wrapped tightly in a sheet of paper; each sample must be marked with the same mark and number as the bale which it represents; provided, however, that it shall be competent for the Chief, Tobacco and Cotton Division, in his discretion to substitute other methods of taking samples in cases in which he deems it desirable so to do."

This method of sampling has several advantages: (1) The sample is truly representative of the bale, as it represents not only the two sides, but also the centre. (2) Cutting into the bale is dispensed with, the bale remains neat and fully covered, and patching, which increases the tare, is obviated. An objection might be raised to the effect that wrong samples may be fraudulently given by the ginner. Experience has shown that this does not happen, nor is it likely to happen, as the ginner has either no interest in the cotton or, if he has, he is aware that any fraudulent practice would harm his name and that, in any case, when detected, he would have to face a claim for differences.

GRADING.

The grading takes place on the samples submitted by the ginner to the Government cotton graders. The bulk of South African cotton is of American Upland varieties, and therefore the grading is based on Liverpool classification for American cotton. The " 1924 Universal Standards " serve as basis from this season onwards. When the work was first undertaken four years ago, there was no model from which to copy, as no other country appeared to have attempted the task. The grader therefore acted as he would have done had he been engaged by a private firm to sell its cotton. Types were established of each quality, and the cotton graded according to same, for instance:—

Type	KAAP	represents	S.G.M. g.c. full 1⅛ inch,
,,	AB	,,	G.M. g.c. good 1⅛ inch,
,,	MAN	,,	S.M. g.c. 1⅛ inch,
,,	ROCK	,,	M. yellow tinged 1⅛ inch,
,,	BTON	,,	S.M. yellow spotted 1 1/16 inch,

and so forth.

Type samples are distributed among all oversea and local firms known to be interested in South African cotton. The aim is to make the types well known and to establish confidence in them on the various cotton markets, by keeping shipments strictly even-running and up to type. A fair measure of success has already attended the policy, as it has brought about the establishment of an active local market, where local firms and buyers from oversea compete for the cotton. Sales generally take place on Government grading certificate, and samples submitted for confirmation to the buyer; the sample is mostly provided by the grader, who returns half of the grading sample to the seller and keeps half for reference. In some cases two samples are taken by the ginner, one to serve as grading and the other as selling sample. Already the necessity to ship the cotton oversea on consignment has disappeared, and as soon as the crop is large enough to enable lots of, say, 100 bales to be offered it will no doubt be possible, if it is felt to be advantageous, to sell on type by cable.

A grading certificate is issued in triplicate in respect of each lot graded. Before export of the cotton is possible one copy must be handed to the port authorities at port of shipment. Each bale must be stencilled on one side or end with the registered mark of the ginner, the number of the bale, and the type mark assigned thereto by the grader.

A fee of 1s. per bale is charged for grading. This charge is nominal, as it does not cover the expenditure incurred to the Government in salary, offices, travelling expenses, etc., of the officials.

GRADERS.

There are two graders, one stationed at Pretoria and the other at Durban. To be eligible, graders must have served the usual apprenticeship, and have had experience in the raw cotton trade in Europe. Their duties include lectures to growers and the giving of advice *re* marketing generally, the markets, their conditions, prices, etc. Their work has also proved of assistance in connection with seed selection and establishment of good seed. Though there is hardly any botanically pure seed in the country, good strains are available producing a uniform staple. The complaint made some years ago of mixed staple is not heard of any more.

The aim constantly held in view is to prepare for the larger crops which no doubt will have to be handled in the near future, and to create marketing conditions ensuring a prompt sale at top prices to the farmer as well as giving satisfaction to the buyer.

C. COTTON GRADING IN QUEENSLAND.

BY
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Director of Cotton Culture, Queensland,
AND
L. L. GUDGE,
Government Cotton Classer, Queensland.

From time to time cotton growing has been practised in Queensland, and it has now become abundantly evident that certain districts of this large state of the Commonwealth are admirably suited for the cultivation of this crop, and also that long staple cotton of good quality can be successfully grown. Up till recently, however, these efforts at cotton growing have been somewhat spasmodic and unorganized, and have depended solely on the price of cotton. Thus, at the time of the American Civil War, when the price of cotton became abnormally high, owing to the scarcity consequent on lack of production in the States, considerable activity resulted in Queensland, and an area of as much as 14,000 acres was cultivated in 1870. When conditions became normal in the States, however, the price of cotton rapidly drifted downwards, and this factor, coupled with the long distance from the markets and the high freights, caused cotton growing to become unattractive in Queensland, and the cultivation consequently declined until 1887. Attempts were made to resuscitate the industry in that year, and again in 1903. In 1913 again the Government made an advance of 1½d. per lb. on seed cotton, and ginned it on owner's account, the final return being equal to 1¾d. per lb.

The great rise in the price of cotton since the termination of the war has once again stimulated interest, and the Queensland Government, in collaboration with the Commonwealth Government, decided in 1920 to make a determined effort to establish cotton growing on a considerable scale and on a permanent basis. In order to encourage growers and to enable them to get an immediate return for their crop, which would otherwise be an impossibility owing to the great distance of the markets of the world for this commodity, the Government in the spring of 1920 announced that a guaranteed advance of 5½d. per lb. would be given for all seed cotton of good quality delivered at the nearest railway station or port. This guarantee was continued for the 1921-22 and 1922-23 seasons, and the immediate result was a large increase in production, which is indicated by the following figures:

Year.	*Acreage.*	*Seed Cotton (Pounds).*	*Value of Crop at 5½d. per Pound.*
1920	166	57,065	£1,308
1921	1,967	940,125	£21,544
1922	7,000	3,876,677	£88,466
1923	28,700	11,769,502	£250,000 (approx.)

This system of guaranteed prices is being continued until July 31, 1926, the conditions of the guarantee to be announced each year and to depend to a large extent on the trend of prices.

The Necessity for Grading.

Under the first guarantee of 5½d. which terminated in 1923, it was announced that the Government would advance 5½d. per lb. for cotton of good quality and free from disease delivered on rail or water. The definition of good quality cotton was "seed cotton that is not ratoon cotton, which is clean, properly picked, and that is not immature, stained, dirty, or otherwise damaged."

Seed cotton found not to be of good quality as defined above might be rejected, subjected to a lesser advance, or treated on grower's account as the Minister might decide. Ratoon cotton was to get an advance of 3d. per lb. only, and was not to be mixed with annual. The sale of the lint from ratoon cotton was to be arranged upon owner's account. It was forthwith ordered that all grading should be under the supervision and direction of officers of the Department of Agriculture and Stock, whose decision in case of any dispute should be final, subject to the right of appeal to the Minister.

This system practically meant that the cotton was really divided into three classes only—viz.:

1. Good annual cotton.
2. Bad annual cotton.
3. Ratoon.

The comparatively large crop harvested in 1922 showed the limitations of this system, but in the absence of trained cotton graders it was all that could then be attempted. It became very evident, however, that some system of grading the seed cotton had to be devised at once. In the first place, owing to the absence of grading, it was impossible to place the lint bales in even running lots, and many of them were uneven in quality and were false packed, the result being that the best prices could not be expected on the market. Secondly, there was no incentive to growers to pick clean; so long as they kept within the wide margin allowed by the definition of "cotton of good quality" they obtained the full guaranteed price. Consequently the Government and the grower were losing a good deal of money, and further, the grower himself was getting a false impression of the value of cotton and of the necessity for clean picking. Finally, it was felt that the reputation for Australian cotton that it was hoped to establish on the world's markets could only be established and maintained if a proper and uniform system of grading was established.

At that time the cotton which was being grown was produced from seed of mixed origin. It was Upland in type, and was descended from several varieties of Upland cotton that had been introduced from time to time in previous years, and had to a small extent been crossed in the field with Egyptian and Sea Island types. The staple was therefore somewhat uneven, but averaged 1⅛ inches. In view of this fact, it was decided that it would be advisable, in the first instance, to concentrate on grading and to leave the stapling until the Durango and other pure varieties which were being tested had been propagated on a sufficient scale to entirely displace the old mixed cotton. This desirable state of affairs will soon be reached now. The question of stapling will be referred to later on.

FIRST ATTEMPTS AT GRADING.

In the early part of 1923 the question of grading first received serious consideration, more especially because the crop that was about to be harvested was very much larger than had ever been produced in a single year before in Queensland. An informal conference was accordingly held at the Whinstanes Ginnery towards the end of March between certain officers of the Cotton Section of the Department of Agriculture and Stock, and of the British Australian Cotton Association. It was agreed that an attempt should be made to start grading in the coming season, but that owing to the inexperience of the ginnery staff and the lack of trained graders it would be advisable to limit the number of grades of seed cotton and to make them as distinct as possible. The grades were to be lettered alphabetically, and bales, in addition to the grade letter, should be numbered and marked with the name of the ginnery. It was also decided that the grades of seed cotton should be made to correspond as nearly as possible to the universal lint standards. The 1923 grades were as follows:

Seed Cotton Grade.	*Corresponding Lint Grade.*	*Guaranteed Price per Pound of Seed Cotton.*
A	Middling fair Good middling	5½d.
B	Good middling Strict middling	5½d.
C	Middling	5½d.
D	Strict low middling Low middling	5d.
E	Lower grades	4d.
F		3d.

These grades were approved by the Minister, and each ginnery had a sample set of seed cotton grades sent for reference, temporary men being appointed to grade the cotton. As was perhaps only to be expected, the grading was not particularly well done, but at any rate a step in the right direction had been taken and the necessity for careful grading was brought home to both the grower and ginner.

A Training Class in Grading.

The importance of grading was at once appreciated by the Government, who immediately decided to secure the services of a first-class cotton classer, and accordingly requested the Empire Cotton Growing Corporation to assist the Agent-General for Queensland in selecting a suitable man. The officer chosen arrived in September, 1923, and was gazetted as Government Cotton Classer. The main difficulty was to secure the services of sufficient graders for the coming season, and the personnel had to be recruited locally. After considerable investigation it was found that young men who had been trained in wool classing seemed to pick up cotton grading more rapidly than others, probably because their eyes had become trained. Eight men of this class were recruited and received a thorough training for six months at the hands of the cotton classer. In the recent season these new graders have been able to do their work satisfactorily, and the result is that the grading of the 1924 crop shows great improvement over that of 1923. It is hoped that in a year or so with constant practice they will become equally proficient in the classing and stapling of the cotton.

The 1924 Grades.

An examination of the prices and valuations obtained for the 1923 crop brought home the fact that there was not quite enough differentiation between the top classes of cotton, and that better results would be obtained if another grade were introduced. Similarly, more distinction was made between the poorer and lower qualities of seed cotton.

In addition, it was found necessary to introduce three grades for spotted or immature cotton, which were designated 1X, 2X, and 3X respectively. The season 1923-24 was a peculiar one. The drought which occurred in the previous season had dried out the subsoil completely, and droughty conditions continued right through the succeeding planting season. A strike at the proper time was consequently only obtained in a few districts, and with difficulty. A short but very hot spell occurred in January, 1924, and this had the effect of causing the bottom crop of bolls to open prematurely in some districts, so that a certain proportion of the first picking in these areas contained immature cotton. Heavy and constant rains in February were accompanied by a serious attack of the maize worm, and this, combined with the prevalence of internal boll rot, caused a certain proportion of the cotton, more particularly in the coastal districts, to be wasty and to contain a number of hard locks. Cotton of this class when ginned would often turn out a good grade, but in the process of ginning quite a considerable weight was lost, since these hard locks were ejected by the ginning machinery and never got down to the saws. As seed cotton of this nature is obviously worth less than good sound cotton of a similar grade, it was found necessary to bring in three immature grades, which were named 1X, 2X, and 3X respectively; 1X, for instance, contained a small amount of waste and " hard " locks, but ginned out a good to strict middling with a slight spot, and the other two grades showing proportionately a higher degree of " spot " and of this loss in ginning.

The grades finally approved for the 1924 season were as follows:

Seed Cotton Grade.	*Corresponding Lint Grade.*	*Guaranteed Price per Pound of Seed Cotton.*
A	Middling fair	5d.
B	Strict good middling	5d.
C	Good middling	5d.
D	Strict middling Middling	5d.
E	Strict low middling Low middling	4½d.
F	Strict good ordinary Good ordinary	4d.
G	Strict ordinary Ordinary	3½d.
1X	Grades of immature and spotted seed cotton	5d.
2X		4½d.
3X		3½d.

Grades for 1925.

For the approaching season the Government has signified its intention of continuing the guarantee on a basis of 5d. for good cotton. The experience of the past season has shown, however, the necessity for making some differentiation in price amongst the four top grades, since many growers had naturally shown an inclination to pick their cotton just cleanly enough to secure the full guaranteed price, whereas the production of a maximum number of bales of the two top grades was obviously desirable, both from the point of view of securing the best prices, and of consolidating the reputation of Queensland cotton on overseas markets. It was accordingly decided, on the recommendation of the cotton advisers attached to the Queensland Agricultural Department, that a small premium should be placed on the two top grades, with the object of encouraging cleaner picking.

The schedule of grades and guarantees finally adopted for 1924-25 crop is as follows:

Seed Cotton Grade.	*Corresponding Lint Grade.*	*Guaranteed Price per Pound of Seed Cotton.*
A	Middling fair	5¼d.
B	Strict good middling	5¼d.
C	Good middling	5d.
D	Strict middling Middling	4¾d.
E	Strict low middling Low middling	4½d.
F	Strict good ordinary Good ordinary	4d.
G	Strict ordinary Ordinary	3½d.
	Immature and Spotted Grades.	
IX	Good middling to strict Good middling spotted	4¾d.
2X	Strict low middling to Middling spotted	4½d.
3X	Strict ordinary to Strict good ordinary	3½d.

It is instructive to note that the necessity for the uniform grading of Upland cotton throughout all parts of Australia was also recognized at a special cotton conference promoted by the Commonwealth authorities in September, 1924, at which the above schedule of grades and prices was adopted throughout Australia for the season 1924-25.

The Methods Adopted.

Owing to the vast distances that occur in Queensland and the scattered nature of the holdings, it must be remembered that most of the cotton has to be railed into the ginneries. The farmer, accordingly, after picking, places his cotton into grain sacks or wool packs and takes it to the nearest railway station. A Government grader is now stationed at each ginnery during the season, and when the truck-loads of seed cotton arrive, they are sorted out in accordance with the Railway Advice Notes into the different consignments. The sacks or wool packs are then slit open by the grader, who takes out sufficient cotton to judge it for grade according to colour and the amount of trash it contains.

Farmers' consignments are then weighed separately under the supervision of a Government check weigher. This is a very necessary feature and entails a lot of work, because the tendency is becoming greater each year for cotton to be cultivated in small individual areas, and consequently as a rule there is not sufficient cotton in any one consignment to make a bale of lint. A recognized tare is deducted for the sack or wool pack, and the cotton is then moved into a large receiving shed and stacked separately, according to the grade. The cotton is now ready for the gin, and is taken in its separate grades to a suction pipe in the receival shed, where the sacks are split open, emptied on the floor, and fed up the suction by an attendant who is armed with a pitchfork to break up the seed cotton and to prevent any foreign substances, which would injure the saws or cause fires, from going through to the gin stands.

In order to check up on the grade of lint cotton, the following procedure is adopted to obtain a sample. A hole is cut in the slide down which the cotton falls from the condenser to the press-box, so that a sample of lint can be drawn at any time during the formation of any particular bale. Any part of the bale can thus be sampled, and this method also avoids the necessity for defacing a bale after it has been pressed and completed ready for shipment. On the other hand, there is the disadvantage that the sample so obtained is entirely unpressed, and is therefore more difficult to judge than a sample drawn from a high-density bale. This method of grading was primarily designed to ensure that the bales of lint should be of as uniform grade as possible, and to eliminate false packed or two-grade bales.

CLASSING AND STAPLING.

A word about the stapling of cotton in Queensland may prove of interest. As explained above, the cotton which has up till now been chiefly grown is an Upland cotton of mixed origin, which is consequently of somewhat uneven staple, but is roughly classed as 1⅛-inch staple. Up to the present, therefore, it has been only found possible to grade this cotton, as in the first place men who were capable of stapling and classing properly were not available, and in the second place the staple was not uniform enough. This mixed cotton, however, is now being rapidly displaced by pure varieties, the chief of which is Durango, of which some 11,000 acres is being planted with acclimatized seed in the coming season 1924-25 in homogeneous areas. Last season between 200 and 300 bales of this variety were produced, and these have been carefully stapled and classed by the Government cotton classer. At the same time the opportunity has been taken to give as intensive a training as possible to the newly recruited graders in this specialized work, and the progress they have made is satisfactory, so that we shall now be in a better position to deal with the large Durango crop that is anticipated from the coming season.

In stapling the Durango crop, the preliminary methods are the same as for grading. When the sacks or wool packs are slit open for grading, several locks are pulled by the classer to judge the staple length, and the bags are then marked with the grade letter and staple number.

Numbers are used to denote the staple length thus:

No. 1 denotes $1\frac{1}{16}$ inch staple.
,, 2 ,, $1\frac{1}{8}$,, ,,
,, 3 ,, $1\frac{3}{16}$,, ,,
,, 4 ,, $1\frac{1}{4}$,, ,,

The Queensland cotton belt covers such an extended area and comprises such a number of different soils and varied climates that the staple of pure variety such as Durango naturally varies somewhat in accordance with the locality. After grading and classing, the seed cotton is stacked into dumps according to the grade and staple, and the different lots are then ginned separately.

CONCLUSION.

A perusal of this article will indicate to the reader that grading is still in its infancy in Queensland, but that the importance of grading and classing has been fully realized by the authorities, and that every step has been taken to ensure that the crop will in the future be marketed to the best advantage. In a new cotton-growing country such as Queensland, the usual difficulty was experienced owing to the absence of trained local personnel, but this is being overcome as rapidly as possible, and a systematic attempt is being made to train men locally in the intricacies of stapling and classing, and the finer points of cotton grading generally.

SPINNING TESTS

INDIAN COTTONS

The following tests on (bale) samples of Indian cottons sent by the Indian Cotton Committee have been carried out with the co-operation of the Oldham Master Cotton Spinners' Association.

Samples of the raw cotton, and of the product after it has passed through the various processes, can be seen at the offices of the British Cotton Growing Association, 333-350, Royal Exchange, Manchester.

Standards are given in italics.

SPINNING TESTS OF INDIAN COTTON.

February, 1925.

Firm Making Test.	*Growth.*	*Bale No.*	*Per Cent. Loss up to Card Sliver, including Invisible Loss.*	*Nominal Counts.*	*Actual Counts at Spindle Point.*	*Lea Strength Test in Lbs.*	*Actual Turns per Inch.*	*Estimated Value Compared with Price of Current Month Futures (Universal Standard).*
No. 1	*American* ..		*8·5*	*Weft 30*	*31·18*	*39*	*21*	*50 pts. on*
				Weft 28	*29·00*	*45·06*	*19·87*	
				Twist 34	*34·27*	*41*	*30·4*	
	1027 ALF (Surat)	6	10·87	Weft 28	30·20	46·125	19·75	30 pts. on
				Twist 34	37·30	37·6	30·4	
	Dharwar No. 1	5	11·25	Weft 30	30·96	47·625	21	45 pts. on
				Twist 34	35·83	43·75	30·4	
	Cambodia ..	2	10·75	Weft 28	29·82	48	20	40 pts. on
				Twist 34	36·89	41	30·4	
No. 2	*Texas American*		*7·12*	*Twist 30*	*33·03*	*48·87*	*20·9*	*75 pts. on*
				,, 36	*36·62*	*42·62*	*22·5*	
				Weft 24	*25·75*	*51·75*	*15·78*	
				,, 28	*28·18*	*55·75*	*17·18*	
	285 F (Punjab-Am)	21	14·36	Twist 30	29·9	59·25	20·9	60 pts. off
				,, 36	33·43	50	22·5	
				Weft 24	23	53·25	15·78	
				,, 28	25·56	52·75	17·18	
	289 F. (Punjab-Am)	22	18·23	Twist 30	28·71	68·62	20·9	125 pts. off
				,, 36	32·56	55·37	22·5	
				Weft 24	21·81	71·50	15·78	
				,, 28	24·06	57·25	17·18	
	Cambodia ..	3	10·09	Twist 30	29·34	54·5	20·9	25 pts. on
				,, 36	33·06	45·5	22·5	
				Weft 24	23·75	58·5	15·78	
				,, 28	25·50	59·5	17·18	

SPINNING TESTS OF INDIAN COTTON.

(Continued.)

Firm Making Test.	*Growth.*	*Bale No.*	*Per Cent. Loss up to Card Sliver.*	*Nominal Counts.*	*Actual Counts at Spindle Point.*	*Lea Strength Test in Lbs.*	*Actual Turns per Inch.*	*Estimated Value Compared with Price of Current Month Futures (Universal Standard).*
No. 3	*Middling American*		*9·63*	*Twist 19*	*20·14*	*77·12*	*15·95*	*15 pts. on*
				,, 12	*12·86*	*137·25*	*12·55*	
				Weft 20	*21·42*	*62·25*	*14·50*	
				,, 14	*14·77*	*108·12*	*11·40*	
	Karunganni ..	8	10·6875	Twist 16	17·80	78·50	15·15	200 pts. off
				,, 10	11·54	132·75	12·10	
				Weft 22	24·05	43·37	15·85	
				,, 10	11·47	59·62	9·25	
	1027 ALF (Surat)	7	10·125	Twist 16	16·92	101·00	14·60	pass
				,, 12	12·86	138·75	11·80	
				Weft 15	16·67	100·12	12·70	
				,, 14	15·21	108·25	11·35	
	Sircar 14 ..	1	15·875	Twist 16	16·73	114·62	14·80	100 pts. off
				,, 10	10·68	204·25	11·30	
				Weft 20	21·39	82·00	14·55	
				,, 14	15·10	121·12	11·60	
	Sircar 25 ..	R1	10·50	Twist 20	23·00	58·37	16·45	50 pts. off
				,, 16	17·65	84·87	15·05	
				Weft 18	20·58	62·75	13·05	
				,, 16	17·99	76·25	13·35	
No. 4	*Boweds American*		*10·2*	*Weft 24*	*23·57*	*45·27*	*15·91*	*25 pts. on*
				,, 20	*21·07*	*51·37*	*14·5*	
	Karunganni ..	9	11·3	Weft 24	23·88	33·75	15·91	150 pts. off
				,, 20	20·93	42·25	14·5	
	Sircar 14 ..	R2	10·88	Weft 24	23·66	60·70	15·91	100 pts. off
				,, 20	20·81	69·12	14·5	
	Gadag No. 1 ..	4	16·75	Weft 24	22·28	68	15·92	75 pts. off
				,, 20	20·53	74	14·53	

TESTS ON INDIAN GROWN COTTON.

SPINNERS' COMMENTS. *No.* 1 *Firm.*

	On the Raw Cotton.					On Behaviour in Working.	On the Yarns Produced.
	Staple (Ins.).	*Seed and Leaf.*	*Colour.*	*Ginning.*	*Generally.*		
1027 ALF (Surat)	$1\frac{1}{16}$	Comparatively free	Good white to cream	Good	Very desirable cotton, but attention should be given to developing staple	Worked fairly well	This sample is very little inferior to this season's Strict Middling American and slightly brighter in appearance
Dharwar No. 1	$1\frac{3}{32}$	Comparatively free	Cream	Good	The colour will prejudice general use, and whiter strain should be cultivated	Worked well	Equal to Strict Middling Boweds in every respect except colour
Cambodia	$1\frac{3}{32}$	Comparatively free	Creamy	Good	The cotton is of a nice silky variety, but value would be increased if colour could be made more like American	Worked well	Very little to choose for even thread or cleanliness. The sample is a very desirable cotton in every respect except colour

TESTS ON INDIAN GROWN COTTON—*Continued.*

SPINNERS' COMMENTS. *No.* 2 *Firm.*

	On the Raw Cotton.					*On Behaviour in Working.*	*On the Yarns Produced.*
	Staple (Ins.).	*Seed and Leaf.*	*Colour.*	*Ginning.*	*Generally.*		
285 F (Punjab Am)	$1\frac{1}{16}$	Too much of both. Also crushed seed with oil stains	White	Not good	This cotton is strong, less neppy than 289 F, but lossy	Did not spin well (uneven and neppy)	This 285 F is in many respects like 289 F, but is better ginned and does not contain so much trash. It is brighter and a better colour than 289 F, but inferior generally, although slightly longer in staple. Stronger in pull than American Texas after allowing for coarse counts. For weft it will spin higher counts than those tested, but it needs to be better ginned and grown from a seed which will give a more even running staple
Cambodia	$1\frac{1}{32}$	Satisfactory	Cream	Satisfactory	This type is nearest to the American-grown cotton	Spun and looks more like American than others tested	This type (Cambodia) spun well. It is much like the Texas against which it was tested. It is the nearest in value to American, and could be used extensively if grown in quantity and kept equal to this bale. Comparing the counts and strength per lea with the American, there was little in them, but 30s T is quite far enough to make a really satisfactory twist yarn. It will spin 32s weft with a low draft

TESTS ON INDIAN GROWN COTTON—*Continued.*

SPINNERS' COMMENTS. *No 2 Firm—Continued.*

	On the Raw Cotton.					*On Behaviour in Working.*	*On the Yarns Produced.*
	Staple (Ins.).	*Seed and Leaf.*	*Colour.*	*Ginning.*	*Generally.*		
289 F (Punjab Am)	$1\frac{1}{16}$	Bad	Dull white or grey	Poor	The waste loss is very heavy. The cotton is strong and free from excessive moisture. Bad for neps	This type is very neppy and spun the worst of the types sampled	Spinners on all counts were unanimous that this type was the worst spinning cotton. Whilst it was longer in staple than other types, its hard character made it the worst spinning cotton even with standard turns in. Its worst features are its neppy character, unevenness, and great waste loss. Taking 13½d. as the value of the F.M. Texas American Cotton it was tested against, it would require to be 2d. per pound cheaper in price for waste loss alone, to say nothing of the inferior yarn it produced in other respects

TESTS ON INDIAN GROWN COTTON—*Continued.*

	SPINNERS' COMMENTS. *No. 3 Firm.*						
	On the Raw Cotton.					*On Behaviour in Working.*	*On the Yarns Produced.*
	Staple (Ins.).	*Seed and Leaf.*	*Colour.*	*Ginning.*	*Generally.*		
Karunganni	$\frac{15}{16}$	Clean	Good and bright, slightly creamy	Fairly well ginned	This cotton is of a very soft nature with very low natural twist. Requires highly twisting to get anything approaching strength of (Universal) Middling American cotton. Suitable only if used alone for very soft yarns about 20s. Worth cultivating for mixing with American	Worked badly with normal conditions; improved with extra twist	Suitable only if used alone up to 20s in soft spun yarns. A nice even yarn; in appearance equal to one spun with American cotton, but would fail by reason of lack of strength
1027 ALF (Surat)	$1\frac{1}{16}$	Slight leaf, but cleans easily	Creamy and bright	Good	Very useful cotton, and large quantities could be used in Lancashire. Fully equal in value to (Universal) Middling American	Very good	This cotton makes a clean, bright yarn of a marketable medium quality. Suitable up to 30s Twist and 40s Weft.
Sircar 14	1	Large amount of small leaf	Creamy	Too much leaf left in	A cotton worth cultivating, but should be sent in cleaner condition. If this was done the cotton would be fully equal to Universal Middling	Good	This cotton produced a good yarn, very strong and even, but rather too much leaf. It is capable of being spun to 36s twist and 40/44s weft of medium quality.
Sircar 25	1	Very clean	Creamy	Fairly well ginned	A cotton worth cultivating. It is slightly below Universal Middling in value, but would be very useful in Lancashire	Did not work well owing to harshness of fibre and difficulty in introducing twist	Makes a clean, bright and even yarn of moderate strength. Compares reasonably with medium quality American yarn. Suitable up to 20s twist and 30s weft.

TESTS ON INDIAN GROWN COTTON—*Continued*.

SPINNERS' COMMENTS. *No. 4 Firm.*

	On the Raw Cotton.					*On Behaviour in Working.*	*On the Yarns Produced.*
	Staple (Ins.).	*Seed and Leaf.*	*Colour.*	*Ginning.*	*Generally.*		
Karunganni	$\frac{15}{16}$	Contains full unbroken seeds, but only slightly leafy	Beautiful creamy white	Too many full seeds, otherwise fairly good	A very nice Indian cotton of fine texture, good colour, bright, and fairly clean, but too short in staple to spin by itself counts higher than 18s to be of commercial value	Very poor spinning, cotton being too soft; will spin up to 18s counts, but to do this will require many extra turns in twisting in both card-room and spinning-room.	—
Sircar 14	$1\frac{1}{32}$	Fairly free from both seed and leaf	Bright but creamy colour similar to Cambodia	Good	A very nice class of Indian cotton. Fine silky texture. Good in colour, staple, brightness, cleanliness, and regularity. Similar to good-class Cambodia. A fair substitute for American Boweds cotton. Will spin by itself into 22s counts of commercial value	Fairly good spinning cotton up to 22s counts. Does not require any extra twisting in card-room, but does require extra twisting in spinning-room.	—
Gadag No. 1	1	Very leafy and much broken seed	Rather dull and creamy	Not satisfactory (too much broken seed)	Fair staple, fine texture, brightness and cleanliness *not satisfactory*. Too short in staple to spin finer than 24s counts by itself to be of commercial value	Good spinning cotton, run in both card-room and spinning-room with same turns as Boweds American. Its peculiar feature is that it leaves quite a quantity of loose fly or fibre on the roller beam of the spinning mule	Will spin nicely up to 24s counts.

THE YIELDING POWER OF PURE STRAINS OF SEA ISLAND COTTON COMPARED WITH THAT OF COMMERCIAL VARIETIES

BY

S. C. HARLAND, D.Sc. (Lond.), F.L.S.

INTRODUCTION.

THE methods to be adopted in the improvement of the yield of any agricultural crop depend on the particular part of the plant which is of commercial value. In the case of cotton, which is cultivated for the unicellular hairs developed on the seed coat, it is possible to analyze the integrated complex "yield" into its morphological and physiological components. Such an analysis has been set forth in two previous papers, in which an account was given of certain experiments carried out in St. Vincent and Montserrat, involving the isolation of pure lines of Sea Island cotton.

It will not be out of place if the broad analysis of yield be again presented.

Lint per acre=Lint per plant × Plants per acre.
||
bolls per plant × lint per boll
||
lint per seed × seeds per boll
||
loculi per boll × seeds per loculus.

This analysis is sufficient for our purpose. It is, however, clear that such a character as lint per seed is in itself complex, and may be considered as being made up of hairs per seed × mean hair weight.

As the outcome of previous work it was concluded that of the morphological characters bearing on yield, weight of lint per seed was the most important, by virtue of the high positive correlation which it exhibits both with weight of lint per boll and weight of lint per acre.

The strain H 9–23–2–13, isolated in Montserrat, is characterized by a weight of lint per boll much in excess of any other known strain, and it therefore became of importance to see how far the magnitude of this character affected the yielding power. Experiments were carried out at the St. Vincent Experiment Station in 1920, in which the yield of certain reputedly homozygous strains of Sea Island cotton was compared with that of commercial varieties.

Method of Testing.—The space available for testing was small in area, rendering the use of scattered plots out of the question. The plan adopted was to employ a " scatter " of individuals, 105 of each of six varieties. A record was obtained of the number of flowers produced daily by each of the 630 plants—a task of some magnitude, and a weekly count was also made of the number of ripe bolls on each plant. The following characters were recorded for each strain: (*a*) mean weight of seed cotton per boll, (*b*) mean weight of lint per boll, (*c*) mean seed weight, (*d*) mean weight of lint per seed, (*e*) mean number of seeds per boll, and (*f*) ginning percentage.

Method of Scatter.—A diagram of the method of scatter is placed below.

Rows.

1	2	3	4	5	6.....to 21 rows.					
4	6	2	4	6	2	..	..	..	..	1=R.M. St. Vincent Commercial.
5	1	3	5	1	3	..	..	.	..	2=B.S. St. Vincent Commercial.
6	2	4	6	2	4	..	..	..	..	3=AK 41 Pure Strain.
1	3	5	1	3	5	..	..	..	..	4=H 23 ,,
2	4	6	2	4	6	..	..	..	..	5=AB 41 ,,
3	5	1	3	5	1	..	..	..	..	6=AJ 9 ,,

etc., to 30 plants.

In the above diagram all the 4's represent single plants of H 23, and all the 6's plants of AJ 9, and so on. The plants were 2 feet apart in rows 4 feet apart, and were grown on a rectangular plot 86 feet long by 60 feet wide. The plot was surrounded on all sides by cotton plants with similar spacing to those in the plot, and was considered to be fairly uniform in respect of soil conditions.

THE EXPERIMENTAL RESULTS.

Table I. contains a summary of the relevant data from the six strains. It will be seen that the number of flowers per plant varies from 96 in strain H 23 to 129 in the commercial type BS. The two commercial types produce a greater number of flowers per plant than any of the pure strains.

Bolls per Plant.—The number of bolls per plant ranges from 47 in AJ 9 to 58 in AB 41, while the lowest number of bolls per plant is found in BS commercial, the strain which produced the largest number of flowers per plant.

For the purpose of computing yield it is necessary to know the weight of lint per boll as well as the number of bolls per plant.

TABLE I.

Strain.	*Flowers per Plant.*	*Bolls per Plant.*	*Bolls to Flowers (Per Cent.)*	*Lint per Boll (Gm.)*	*Lint per Plant (gm.)*	*Increase over RM. (Per Cent.)*
RM ..	121	57±1·4	47	0·78	44·6±1·1	0
BS ..	129	50±1·1	39	0·88	43·7±0·9	- 2
AK 41 ..	113	52±1·0	46	1·03	53·0±1·1	+23
H 23 ..	96	52±0·7	54	1·28	66·6±0·9	+52
AB 41 ..	118	58±1·2	49	0·85	49·3±1·0	+11
AJ 9 ..	104	47±1·0	45	0·92	42·9±0·9	- 4

In Table I. the results for weight of lint per plant, obtained by multiplying lint per boll by number of bolls per plant, are subject to a mean probable error of 2 per cent. Thus, if any two strains differ by more than 3·2 times the probable error—*i.e.*, by more than 6·4 per cent.—the yielding power is significantly different. A difference of 6·4 per cent. corresponds to a 30 to 1 chance against the result occurring in random sampling. It is not necessary to discuss the differences in yield in detail, but it is worthy of note that three pure strains out of four are superior to the commercial types. In particular, the two strains H 23 and AK 41 show increases of considerable magnitude, which are to be attributed to their greater boll weight. The strain AJ 9, which has a fairly high boll weight, is lowest in yield per plant owing to its low number of bolls per plant, while AB 41, with a comparatively low boll weight, yields more than the commercial types because of the greater number of bolls per plant. It may be mentioned that AB 41 was selected as representing a group of strains characterized by a large number of bolls per plant.

Further data of agricultural interest are presented in Table II.

TABLE II.

Strain.	*Seed Cotton per Boll (Gms.).*	*Lint Percentage.*	*Lint per Seed (Mgm.).*	*Seed Weight (Mgm.).*	*Seeds per Boll.*
RM ..	3·16	24·7	43	131	18·2
BS ..	3·44	25·5	41	120	21·4
AK 41 ..	3·65	28·1	52	133	19·7
H 23 ..	4·24	30·4	59	136	21·7
AB 41 ..	3·23	26·4	46	128	18·6
AJ 9 ..	3·44	26·8	57	156	16·2

The above table throws a little more light on the variation in yield of the strains. AJ 9, for example, has an abnormally low number of seeds per boll, which lowers the weight of lint per boll, while H 23 is seen to have an exceptionally favourable grouping of desirable morphological characters—a high weight of lint per seed, and a high number of seeds per boll.

General Considerations.

The results from the experiments described above demonstrate the importance of a detailed study of how the yield of a strain may be affected by its morphological and physiological characteristics. The agricultural superiority of H 23, isolated from a commercial stock as the outcome of experiments designed to raise weight of lint per boll to the maximum, is definitely established for the particular environmental conditions prevailing during the experiment. Under other environmental conditions the morphological superiority could conceivably be masked by other characters coming into play. The final proof that one strain is agriculturally better than another for any one particular locality must be the outcome of a series of experiments conducted in a sufficient number of seasons to ensure that the "model" environmental conditions have been experienced.

There is a defect in the way the experiments were planned which must be pointed out. With the method of scatter used, a single plant of any individual strain is surrounded by a ring of plants belonging to other strains, and its yield must be influenced by root competition, which would probably be different in its effects from root competition of plants of the same strain. It would be advisable in future experiments to grow blocks of nine plants of each strain, and take records from only the middle plant.

Summary.

1. The yield of six types of Sea Island, consisting of four pure strains and two commercial varieties, was compared in terms of weight of lint per plant.

2. Three pure strains out of four proved to be more productive than the commercial varieties, the increase in yield in strain H 23 being 52 per cent.

3. The agricultural superiority of H 23 under the conditions of the experiment is regarded as being due chiefly to a favourable combination of morphological characters, which result in a high boll weight. The number of bolls per plant differs little from that of the commercial types.

COTTON GROWING STATISTICS—V.

BY

JOHN A. TODD

In the first issue (January, 1924) we gave a table of the World's Cotton Crops, and since then we have given detailed tables of the chief Empire crops, and also (in the issue of January, 1925) a table of the Egyptian crop, because that was necessary in order to give a complete view of the position with regard to the supply of fine cotton. In the same way it is necessary now to give further details of the American crop, because that still dominates the world's supply of cotton as a whole, and particularly the supply of medium or "bread and butter" cotton—*i.e.*, cotton averaging approximately 1 inch in staple. The following table brings out the fact that even in recent years America has supplied over 50 per cent. of the world's total crops, and nearly 90 per cent. of the total supply of Medium cotton.

TABLE VII.—POSITION OF AMERICAN COTTON IN THE WORLD'S SUPPLIES.

Bales of 500lbs. (approx.); 000's omitted.	1914.	1920.	1921.	1922.	1923.	1924.*
World's crops	27,883	21,448	16,671	20,119	21,090	*25,851*
American	16,738	13,700	8,360	10,320	10,840	*13,903*
Percentage of total ..	***60***	***64***	***50***	***52***	***52***	***54***
Grade II. Medium.						
Brazilian	406	453	570	571	631	*650*
Mexico	112	211	155	151	201	*200*
Other South American ..	14	38	61	71	*121*	*150*
East African (British) ..	43	96	55	113	161	*250*
Nigeria	15	30	15	17	25	*25*
Other African	3	13	16	*20*	20	*20*
Australia and Mesopotamia	—	1	3	11	16	*34*
Indian (long staple) ..	*150*	*200*	*200*	*250*	*400*	*500*
Russia	*500*	*20*	*20*	*25*	*100*	*150*
Others (China, Korea, etc.)	*250*	*250*	*250*	*250*	*250*	*250*
American	16,738	13,700	8,360	10,320	10,840	*13,903*
Total	18,231	15,012	9,705	11,799	12,765	*16,132*
American percentage of Grade II	***91·9***	***91·3***	***86·1***	***87·5***	***85·1***	***86·2***

Estimates.

Table VIII. (1) gives a detailed history of the American crop (area, crop, yield per acre, and price) since 1899. From this history two interesting facts emerge:

(*a*) The yield per acre shows, on the whole, a steady decline since 1914, and especially since 1920. Even 1924 shows badly, except against its three predecessors. As a matter of fact, the history of the American yield per acre can be carried back to 1866, just after the Civil War, and this longer record shows three distinct periods: (1) 1866-83, during which the average yield was falling, on the whole, due to the aftermath of the war and slavery. (2) 1884-1914, when the average yield rose on the whole, with some bad dips (especially 1893 and 1909). This rise was due mainly to improved cultivation and the spread of cotton growing to virgin land further west. (3) The fall since 1914 is mainly the result of the advent of the boll weevil to the eastern states, where its progress was extremely rapid owing to favourable climatic conditions.

(*b*) There is definite evidence in the figures of area crop and price of a vicious circle; thus a big crop means a low price, which results in a reduced acreage being planted next year and (other things being equal) a smaller crop. This leads to higher prices again, and produces a recovery of the acreage and crop in the third year, followed once more by lower prices, and so on. Hence the tradition in Lancashire that a big crop is always followed by a small one, and *vice versa*. The correlation between the price each season and the area planted in the following year is very remarkable, especially if the high prices since 1914 are discounted by the index numbers of general prices so as to eliminate the effects of inflation during the war period and the post-war boom.

Table VIII. (2) gives details for each of the principal states since 1913. An examination of the history of the yield per acre in each state brings out very clearly the effect of boll weevil. For reference on this point the dates are given against each state: (*a*) when boll weevil was first reported in the state; (*b*) when the infestation was reported throughout the whole of the state; and it is interesting to note the sharp fall in the yield, which nearly always comes within a year of the latter date. There is, however, a very peculiar coincidence in the fact that in nearly every case the maximum yield in each state is recorded in *the year before the collapse*, which in many cases is just the year in which complete infestation is reported. Thus, in South Carolina complete infestation was reported about 1920. That year the average yield was 260 pounds; in 1921 it was 140 pounds. In North Carolina complete infestation was reported in 1922. In 1923 the average yield was 290 pounds, which has not been equalled since 1914. In 1924 the yield has fallen to 192 pounds. In Virginia the facts are similar. (It should, however, be noted that these three states were peculiarly unfortunate in their weather in 1924, the conditions being very favourable to boll weevil.) The explanation probably is that the report of complete infestation merely means that single specimens have been found widely scattered throughout the state, but this stage anticipates by about a year the period when infestation results in heavy damage.

Table VIII. (2) also brings out what might be called the westward march of the acreage. The acreage in the Atlantic States has, on the whole, not increased since 1913, except in Virginia and North Carolina, where the absence of boll weevil produced a steady increase up till 1924. It is again very noticeable how the acreage drops in most cases immediately after the fall of yield due to boll weevil. In the middle states there has not been much change of acreage, as a whole, in the period covered by the table, but the western states, especially Texas, Arkansas, and Oklahoma, account for by far the greater part of the total increase in recent years, and especially of the record acreage of 1924, when Texas alone is reported to have harvested 16,198,000 acres, and the acreage planted as at present reported was still greater—namely, 16,699,000. Thus the position in the United States may be summed up as a struggle between acreage and boll weevil.

There has been a great deal of discussion in recent years with regard to the reliability or otherwise of American statistics, and much of the criticism has been misdirected. As a matter of fact, the chief source of error is in the acreage statistics. The first estimate of acreage *planted*, published on July 2, gives area planted and still in cultivation as at June 25, but no information as to how much has been abandoned prior to that date. This area planted is now, as a rule, revised in December, but the final revision is not settled till June 2 of the following year, when it appears with the first Condition Report. The first estimate of acreage *harvested* is published in December, and revised in June next year. Table VIII. (3) gives a history of these various acreages and the abandonment since 1908, and shows the effect of the various revisions. It will be noted that the revision of the acreage planted is nearly always upwards and substantial, averaging 949,000 acres, or 2·7 per cent., while the acreage harvested is generally revised downwards. The acreage abandoned shows, on the whole, a remarkable similarity to the upward revision of the acreage planted. This apparently normal under-estimation of the area planted is the inevitable result of circumstances and the methods adopted. The chief difficulty is the enormous area to be covered (the total area of the Cotton Belt is about 700,000 square miles, or about six times the area of the United Kingdom) and the lack of a detailed cadastral survey. The basis of the estimate is an actual enumeration by the Census Bureau, but this can only be made every ten years, and the new figure for each year is estimated as a percentage increase or decrease on the previous year. Improvements are being made every year in the actual methods employed in making the estimate, but in dealing with so large an area such methods can never be perfect.

TABLE VIII (1).—AMERICAN ACREAGE, CROP, YIELD PER ACRE, AND PRICE, 1899-1924.

Season.	*Acreage Harvested* (000's).	*Crop (Running Bales, 000's).*			*Average Yield* (*Lbs. per Acre*) (*Ex Linters*).	*Average Price Middling* (*Pence per Lb.*).
		Cotton.	*Linters.*	*Total.*		
1899–1900	24,275	9,393	115	9,508	183·8	4·87
1900–01	25,758	10,102	144	10.246	194·4	5·16
1901–02	27,220	9,583	166	9,749	170·0	4·78
1902–03	27,114	10,588	196	10,784	187·3	5·46
1903–04	28,017	9,820	196	10,016	174·3	6·94
1904–05	30,054	13,451	246	13,697	205·9	4·91
1905–06	26,117	10,495	231	10,726	186·6	5·95
1906–07	31,374	12,983	322	13,305	202·5	6·38
1907–08	31,311	11,058	268	11,326	179·1	6·19
1908–09	32,444	13,086	346	13,432	194·9	5·50
1909–10	32,044	10,073	313	10,386	154·3	7·86
1910–11	32,403	11,568	398	11,966	170·7	7·84
1911–12	36,045	15,553	556	16,109	207·7	6·09
1912–13	34.283	13,489	602	14,091	190·9	6·76
1913–14	37,089	13,983	631	14,614	182·0	7·26
1914–15	36,832	15,906	832	16,738	209·2	5·22
1915–16	31,412	11,068	945	12,013	170·3	7·51
1916–17	34,985	11,364	1,300	12,664	156·6	12·33
1917–18	33,841	11,248	1,096	12,345	159·7	21·68
1918–19	36,008	11,906	910	12,817	159·6	19·73
1919–20	33,566	11,326	595	11,921	161·5	25·31
1920–21	35,878	13,271	429	13,700	178·4	11·89
1921–22	30,509	7,978	382	8,360	124·5	11·37
1922–23	33,036	9,729	591	10,320	141·3	14·92
1923–24	37,123	10,171	669	10,840	130·6	17·66
1924–25	40,115	13,153*	750†	13,903	156·8	—

* Government's December estimate, which will certainly be exceeded, say, 13,500,000.

† Private estimate.

TABLE VIII (2).—AMERICAN AREA, CROP AND YIELD PER ACRE, BY STATES, 1913-1924.

State.	*Weevil Dates.*		1913–14.			1914–15.			1915–16.			1916–17.			1917–18.			1918–19.		
	(*a*).	(*b*).	*Area Picked* (*Acres*, 000's).	*Crop* (500-*Lb. Bales*, 000's).	*Yield per Acre* (*Lbs.*)	*Area Picked* (*Acres*, 000's).	*Crop* (500-*Lb. Bales*, 000's).	*Yield per Acre* (*Lbs.*).	*Area Picked* (*Acres*, 000's).	*Crop* (500-*Lb. Bales*, 000's).	*Yield per Acre* (*Lbs.*).	*Area Picked* (*Acres*, 000's).	*Crop* (500-*Lb. Bales*, 000's).	*Yield per Acre*, (*Lbs.*).	*Area Picked* (*Acres*, 000's).	*Crop* (500-*Lb. Bales*, 000's).	*Yield per Acre* (*Lbs.*).	*Area Picked* (*Acres*, 000's).	*Crop* (500-*Lb. Bales*, 000's).	*Yield per Acre* (*Lbs.*).
Virginia ..	1922	1923	47	23	240	45	25	265	34	16	225	42	27	310	50	19	180	44	25	270
N. Carolina	1919	1922	1,576	793	239	1,527	931	290	1,282	699	260	1,451	655	215	1,515	618	194	1,600	898	268
S. Carolina	1917	1920	2,790	1,378	235	2,861	1,534	255	2,516	1,134	215	2,780	932	160	2,837	1,237	208	3,001	1,570	250
Georgia ..	1914	1919	5,318	2,317	208	5,433	2,718	239	4,825	1,909	189	5,277	1,821	165	5,195	1,884	173	5,341	2,122	190
Florida ..	1910	1918	188	59	150	221	81	175	193	48	120	191	41	105	183	38	100	167	29	85
Alabama	1909	1915	3,760	1,495	190	4,007	1,751	209	3,340	1,021	146	3,225	533	79	1,977	518	125	2,570	801	149
Mississippi	1907	1914	3,067	1,311	204	3,054	1,246	195	2,735	954	167	3,110	812	125	2,788	906	155	3,138	1,226	187
Louisiana	1903	1907	1,244	444	170	1,299	449	165	990	341	165	1,250	443	170	1,454	639	210	1,683	588	167
Texas ..	1892	1910	12,597	3,945	150	11,931	4,592	184	10,510	3,227	147	11,400	3,726	157	11,092	3,125	135	11,233	2,697	115
Arkansas ..	1906	1916	2,502	1,073	205	2,480	1,016	196	2,170	816	180	2,600	1,134	209	2,740	974	170	2,991	987	158
Tennessee	1915	1921	865	379	210	915	384	200	772	303	188	887	382	206	882	241	130	902	330	175
Missouri ..	1921	1922	112	67	286	145	82	270	96	48	240	133	63	225	153	61	190	148	62	200
Oklahoma	1905	1919	3,009	840	132	2,847	1,262	212	1,895	640	162	2,562	824	154	2,783	959	165	2,998	577	92
California ..	—	—	14	23	500	47	50	500	39	29	380	52	44	400	136	58	242	85	67	270
Arizona ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	41	22	285	95	56	280
New Mexico	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Others ..	—	—	—	10	—	20	14	335	15	7	217	25	14	260	15	6	175	12	6	250
Totals ..			37,089	14,156	182·0	36,832	16,135	209·2	31,412	11,192	170·3	34,985	11,450	156·6	33,841	11,302	159·7	36,008	12,041	159·6

TABLE VIII. (2).—AMERICAN AREA, CROP, AND YIELD PER ACRE, BY STATES,

1913-1924—*Continued.*

State.	*Weevil Dates.*		1919–20.			1920–21.			1921–22.			1922–23.			1923–24.			1924–25.		
	(*a*).	(*b*).	*Area Picked* (*Acres,* 000's).	*Crop* (500-*Lb. Bales,* 000's).	*Yield per Acre* (*Lbs.*).	*Area Picked* (*Acres,* 000's)	*Crop* (500-*Lb. Bales,* 000's).	*Yield per Acre* (*Lbs.*).	*Area Picked* (*Acres,* 000's).	*Crop* (500-*Lb. Bales,* 000's).	*Yield per Acre* (*Lbs.*).	*Area Picked* (*Acres,* 000's).	*Crop* (500-*Lb. Bales,* 000's).	*Yield per Acre* (*Lbs.*).	*Area Picked* (*Acres,* 000's).	*Crop* (500-*Lb. Bales,* 000's).	*Yield per Acre* (*Lbs.*).	*Area Picked* (*Acres,* 000's).	*Crop* (500-*Lb. Bales,* 000's).	*Yield per Acre* (*Lbs.*).
Virginia ..	1922	1923	42	23	255	42	21	230	34	16	230	55	27	230	74	51	325	89	30	161
N. Carolina	1919	1922	1,490	830	266	1,587	925	275	1,403	776	264	1,625	852	350	1,679	1,020	290	1,901	756	192
S. Carolina	1917	1920	2,835	1,426	240	2,964	1,623	260	2,571	755	140	1,912	492	123	1,965	770	187	2,236	750	160
Georgia ..	1914	1919	5.220	1,660	152	4,900	1,415	138	4,172	787	90	3,418	715	100	3,421	588	82	3,183	1,000	150
Florida ..	1910	1918	103	16	74	100	18	86	65	11	80	118	25	102	147	12	40	81	22	130
Alabama	1909	1915	2,791	713	122	2.858	663	111	2,235	580	124	2,771	823	142	3,079	587	91	3,073	990	154
Mississippi	1907	1914	2,848	961	160	2,959	895	145	2.628	813	148	3,014	989	157	3,170	604	91	2,997	1,080	172
Louisiana	1903	1907	1,527	298	93	1,470	388	126	1,168	279	114	1,140	343	144	1,405	368	125	1,560	480	147
Texas ..	1892	1910	10,476	3,099	140	11,898	4,345	174	10,745	2,198	98	11,874	3,222	130	14,150	4,342	147	16,198	4,770	141
Arkansas ..	1906	1916	2.725	884	155	2,980	1,214	195	2,382	797	160	2,799	1,018	173	3,026	628	98	3,150	1,100	167
Tennessee	1915	192.	758	310	195	840	325	185	634	302	228	985	391	190	1,172	228	92	986	330	160
Missouri ..	1921	1922	125	64	257	136	79	275	103	70	325	198	143	360	355	121	171	410	146	170
Oklahoma	1905	1919	2,424	1,016	195	2.749	1,336	230	2,206	481	104	2,915	627	103	3,197	656	98	3.791	1,450	183
California ..	—	—	85	56	268	150	75	266	55	34	258	67	28	188	83	54	285	130	71	261
Arizona ..	—	—	107	60	270	230	103	224	90	45	242	101	47	222	127	78	292	184	100	260
New Mexico	—	—	—	—	—	—	—	—	—	—	—	—	—	—	60	28	230	109	56	245
Others ..	—	—	10	5	250	24	13	252	18	9	231	44	19	208	13	6	226	37	13	168
Totals ..			33,566	11,421	161·5	35,878	13,440	178·4	30,509	7.954	124·5	33,036	9,762	141·3	37,123	10,140	130·6	40,115	13,153	156·8

TABLE VIII. (3).—AMERICAN COTTON CROP.

Acreage Planted and Harvested and Abandonment, according to the Various Estimates of the Department of Agriculture.

Crop.	*Planted.*				*Harvested.*			*Abandonment.*	
				000's	*omitted.*				
	1*st.*	2*nd.*	*Final.*	+ or − (3) *on* (1).	1*st.*	*Final.*	+ or − (5) *on* (4)	(5) *on* (3)	*Per Cent. on* (3)
	(1)	(2)	(3)		(4)	(5)			
1908 ..	32,081	—	33,370	+ 1,289	—	32,444	—	926	2·8
1909 ..	31,918	—	32,292	+ 374	—	32,044	—	248	0·8
1910 ..	33,196	—	33,418	+ 222	—	32,403	—	1,015	3·0
1911 ..	35,004	—	36,681	+ 1,677	—	36,045	—	636	1·7
1912 ..	34,097	—	34,766	+ 669	—	34,283	—	483	1·4
1913 ..	35,622	—	37,458	+ 1,836	—	37,089	—	369	1·0
1914 ..	36,960	—	37.406	+ 446	—	36,832	—	574	1·5
1915 ..	31,535	—	32,107	+ 572	—	31,412	—	695	2·2
1916 ..	35,994	—	36,052	+ 58	35,239	34,985	−254	1,067	3·0
1917 ..	34,600	—	34,925	+ 325	33,634	33,841	+207	1,084	3·1
1918 ..	37,073	—	37,207	+ 134	35,890	36,008	+118	1,199	3·2
1919 ..	33,960	—	35,133	+ 1,173	33,344	33,566	+222	1,567	4·5
1920 ..	35,504	—	37,043	+ 1,539	36,383	35,878	−505	1,165	3·1
1921 ..	26,519	32,332	31,678	+ 5.159	31,427	30,509	−918	1,169	3·7
1922 ..	34,852	34,485	34,016	− 836	33,742	33,036	−706	980	2·8
1923 ..	38,287	39,224	38,701	+ 414	37,420	37,123	−297	1,578	4·1
1924 ..	40,403	41,490	—	+ 1,087	40,115	—	—	1,375	3·3
Averages				+ 949 or 2·7% (17 yrs.)			−266 (8 yrs.)	951 (17 yrs.)	2·7

ERRATUM

In Table V. (*a*) in the January issue (Egyptian Area, etc.), at the bottom of the third column, the Government estimate, printed as 6,880 (thousands), should be 6,380.

THE INSTITUTE OF PLANT INDUSTRY, INDORE

A NEW Research Institute for the improvement of crops, at which special attention will be paid to cotton and to the fundamental problems underlying the production of this crop in India, was formally inaugurated at Indore in Central India on November 24, 1924. The foundation of this new Institute has been rendered possible by the provision of a valuable site of 300 acres by the Indore Durbar, by a grant of two lakhs of rupees (about £15,000) for capital expenditure by the Indian Central Cotton Committee, and by an annual contribution of 120,800 rupees a year (a little more than £9,000) for current expenses in addition to the income derived from the land at the disposal of the Institute. This annual grant has been provided jointly by the Indian Central Cotton Committee and by seven of the Central India States (Indore, Dhar, Jaora, Datia, Rutlam, Dewas senior branch, Narsingharh, and Sitamau). The control of the Institute has been vested in a governing body of six members, with the agent to the Governor-General in Central India as president. Three members of the Board of Governors are nominated by the Indian Central Cotton Committee, one by the Indore Durbar, and two by the rest of the contributing States. The director of the Institute will act as Agricultural Adviser to the States, and will in this way come in direct touch with the Malwa plateau, one of the most important cotton tracts in India. The experimental area, which has been leased by the Indore Durbar to the Institute for ninety-nine years at a nominal rent of £20 a year, embraces all the types of black cotton soil met with in India, and is very favourably situated for research work on crops. It is close to the city of Indore, now rapidly growing in importance as a commercial, manufacturing and educational centre, and to the cotton mills. The maintenance of an up-to-date library on crop production, and the training of post-graduate students selected by the Indian Central Cotton Committee, will be features of the Institute. Mr. Albert Howard, C.I.E. (formerly Imperial Economic Botanist at the Agricultural Research Institute, Pusa), has been appointed Director of the Institute, and Agricultural Adviser to the States in Central India, and Mrs. Howard (formerly Second Imperial Economic Botanist at Pusa) will be employed as Physiological Botanist at Indore.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

167. CROP PRODUCTION IN INDIA: A CRITICAL SURVEY OF ITS PROBLEMS. By Albert Howard, C.I.E., M.A., Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India. (Oxford, 1924.) A carefully reasoned study of the many problems of wide importance that must be brought to some kind of solution before agriculture in India can really progress with any rapidity. Such are the questions of surface-drainage, soil-aeration, the nitrogen supply, and the alkali problem. In the second part of the book the various crops are dealt with, and among them cotton, which is treated in some detail, with a most useful list of literature bearing on the subject. The most promising lines of research for the improvement of Indian cotton are pointed out, chiefly under two heads: varietal and environmental factors. No one interested in the amelioration of Indian cotton or other crops can afford to be without this book, written by one who has himself done so much work in this direction, at the same time that much brilliant research has been turned out by Mrs. Howard.

168. In the Report of the Department of Agriculture for Agra and Oudh for the year ending June 30, 1924, it is stated that the main event of the year has been the establishment of a cotton (Aligarh 19) produced by Dr. Parr. This cotton has excellent agricultural characters, and has received the general approval of both spinners and growers. The results of spinning tests carried out on the cotton are given. It is also stated that the Agricultural Department has now definitely concentrated, with excellent results, on the improvement of yield, ginning, and lint characters of local cottons, and on the investigation of means of reducing the enormous annual loss caused by insect pests, notably the pink boll worm.

169. We have received a copy of the Annual Report of the Indian Central Cotton Committee for the year ending August 31, 1924. The subjects dealt with under the heading "Work of the Year" include the following: The successful working of the Cotton Transport Act; regulation of gins and presses; open cotton markets; cleaner picking of cotton; mixing of Punjab-American cotton; spinning tests on Indian cottons; research, etc. The report contains a list of the personnel of the Committee and of the Sub-Committees, and is furnished with several appendices dealing with legislation and other matters relative to cotton cultivation in India.

Also included in the above report is the Annual Report of the Director of the Technological Research Laboratory, containing an interesting account of the objects and work of the Laboratory, with a description, illustrated by photographs, of the buildings and equipment.

170. MYSORE COTTONS AND THEIR IMPROVEMENT. By V. N. Ranganatha Rao. (*Tropical Agriculturist*, vol. lxiii., 1924, pp. 210-213.) A report on selection work carried out in Mysore Province with three varieties of Sannahatti cotton, with a view to effecting improvement in the colour, yield, and ginning outturn.

171. CAMBODIA COTTON: CULTIVATION IN MADRAS. (*Indian Text. J.*, **34**, 1924; abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 13, 1924, E. 30.)

172. COTTON SPINNING IN INDIA. By S. D. Saklatvala. (*Ind. Text. J.*, Nov., 1924, p. 51.)

173. We have received the following reports:

Annual Report of Indian Central Cotton Committee for the year ending August 31, 1924.

Annual Report of the Agricultural Stations of the Western Circle (Agra and Oudh) for the year ending May 31, 1924.

Annual Report of Administration of Department of Agriculture for Agra and Oudh for the year ending June 30, 1924.

Annual Report of Agricultural Stations of Central Circle, Cawnpore, for the year 1923-24.

(*Cf.* also Abstracts 247, 259, 278.)

COTTON IN THE EMPIRE (OTHER THAN INDIA).

174. The following Annual Reports have recently been received:

South Africa	Annual Report of Department of Agriculture for the year ended June 30, 1924.
Tanganyika Territory ..	Report for the fifteen months ended March 31, 1924.

175. THE PART PLAYED BY OUR EMPIRE IN THE PRODUCTION OF RAW COTTON. By W. H. Himbury. (*J. of Text. Inst.*, vol. xv., 1924, p. 170.) A general survey of cotton production in India, the Sudan, Nigeria, Uganda, Nyasaland, Tanganyika Territory, Kenya Colony, South Africa and Rhodesia, Australia, West Indies, Iraq and Ceylon.

176. CEYLON: *Cotton Cultivation.* (*Ind. Text. J.*, 1924, **34**, 365-6. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 20, 1924, E. 66.) A vigorous experimental programme is being instituted in many parts of Ceylon. The Sinhalese take to cotton growing readily, and, as a result of earlier successful trials, 1,649 acres were sown in the Hambantota District last season. There is every reason to hope that the new crop will be gathered from between 2,000 and 3,000 acres. Successful cotton growing is anticipated also in Matale North and in the Uva Province.

177. IRAQ. Advices from Iraq state that the late pickings of last season's cotton crop were poor, and the early pickings good. Usually the reverse is the case, the earlier pickings being poor, and the late ones good. The small number of bolls on plants led to an enormous increase in the percentage of boll-worm attack, though the boll-worm population was probably under normal.

From a report of experiments carried out at the Government Experiment Farm at Rustam we learn that the bulk crop of cotton grown there gave an average yield of 800 pounds of seed cotton per acre over an area of 95 acres. The different varieties of cotton under experiment gave yields varying from 1,341 to 1,945 pounds per acre up to the end of November, with an average yield of 1,695 pounds per acre as compared with 1,537 and 2,110 pounds for complete crops for the two preceding years. The variety that gave the lowest yield in the year's experiments was the local variety grown yearly for purposes of comparison. The cotton pickings from plots grown after lucerne and heurteman showed about 25 per cent. better yield than those following bare fallow.

178. AFRICA: GOLD COAST. *Cotton Cultivation.* (*Times Trade and Eng. Supplt.*, November 1, 1924, p. 139. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 20, 1924, E. 67.) The prospects for cotton growing under irrigation on a large scale, especially along the lower reaches of the Volta River, are thought to be exceptional. The Deputy Director of Agriculture states that, in this area, export facilities are good, and the crop can be grown independently of climatic conditions; while large scale production would ensure systematic cultivation, with increased yield and lower production costs. The crops suitable for a complete rotation are sugar-cane, tobacco, ground nuts, and native food crops.

179. Kenya. *Cotton Cultivation in Kenya.* (*Times Trade and Eng. Supplt.*, November 8, 1924, p. 165.)

180. Nigeria. From a Report on the Cotton Industry, 1924, received from the Agricultural Department, we quote the following: "In view of the erection of a ginnery at Gusau, and the prospects of the construction of a railway in the same area, seed has been distributed for the first time in the whole of the area in Eastern Sokoto (*i.e.*, as far westward as Bakura), which these measures are expected to "open up." It is hoped that in two or three years' time these areas will yield seed cotton equivalent to some 10,000 bales for the ginnery at the terminus of the railway, so that including the arrivals at intermediate stations, the new railway should collect some 20,000 bales very soon after it is opened."

The report also states that the grading measures, introduced the previous year by arrangement with the British Cotton Growing Association, have resulted in an increase in the proportion of first grade seed cotton of from 53 to 94 per cent.

181. Rhodesia (Northern). From a report of a recent tour of the cotton districts made by Mr. T. C. Moore, Cotton Expert for Northern Rhodesia, we learn that the cotton planted this season has not been so successful to date as might have been expected, in view of the early date of the first ploughing rains.

Due principally to the lack of knowledge in handling planters, and to the fact that only a few growers realized how imperative it was to plant shallow and thick, the first cotton planted was either too deep or too thin, or both, with the result that when the heavy rains fell the planter tracks were filled with silt, and the seed was buried from 3 to 4 inches under the surface. A large quantity of the land has, however, been reploughed and replanted, and some is being cleaned up, and the blanks planted in by hand.

To guard against possible loss from the heavy rains in January and February, growers have been advised to cultivate and hoe out all weeds, dig drains to prevent flooding, and ridge the cotton slightly to increase the surface of evaporation, and lead water away from the stems of the plants. Advice has also been given as to the best methods of handling and thinning out the cotton.

The effects of a shortage of labour are being felt by some of the farmers.

There has been a serious outbreak of cutworm on some lands, but the attack is considered to be nearly over. Cotton stainer is also in evidence.

In conclusion, Mr. Moore states that there are approximately 18,000 acres under cotton, and, given more sunshine and a little less rain from now to the end of March, excellent crops should result.

182. Rhodesia (Southern). *Cotton Growing and Irrigation.* By A. C. Jennings. (*Rhod. Agr. J.*, vol. xxi., p. 629, 1924.) The author states that the land to be used for cotton growing should be well prepared and generally in good condition for irrigation. It should then receive a heavy watering, giving deep penetration up to 18 to 24 inches, and be lightly cultivated immediately before planting. The crop will be sown in the usual way, with the seeds about 15 inches apart in the rows, and the rows about 3 feet 6 inches apart, and so placed that water can be led between them without scouring the land. Another cultivation should be given as soon as the plants are showing up in the rows, and further irrigation delayed as long as possible in order to encourage deep rooting. If no rains have occurred to carry on the crop, a further irrigation can then be given. It will possibly be found in most parts that one or two irrigations at the most will suffice to establish the crop until it is carried on by the rains.

183. The *Rhodesia Agr. Journ.*, vol. xxi., 1924, p. 756, states that arrangements have been made with the British Cotton Growing Association for financing the shipment of cotton to England; 60 per cent. of the value will be advanced locally on all clean white cotton at 1 per cent. over English bank rate.

184. *Advice to Cotton Growers in Southern Rhodesia.* By O. C. Rawson. (*South Afr. Cott. Growers' J.*, vol. i., 1924, p. 37.)
(*Cf.* also Abstracts 229, 230, 261.)

185. *Matabeleland: Cotton Cultivation.* (*Cott. News Weekly*, 1924, **1**, 14, p. 334. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 21, 1924, E. 75.)

186. SOUTH AFRICA. *Cotton in South Africa.* By W. H. Scherffius and J. du P. Oosthuizen. (South Africa Central News Agency, Ltd. Price 21s. net.) The appearance of this book will be welcomed by all interested in cotton growing in South Africa. The authors have been intimately connected with the later developments of the industry in the Union, and are therefore in a position to write authoritatively on the subject. The objects of the publication, as described in the Preface, are twofold: (1) to supply a handbook for cotton growers in South Africa; (2) to furnish a textbook for school and college students. This is an admittedly difficult task in respect to any field crop, although probably somewhat easier in the case of cotton, which has an important commercial and industrial side connected with it. It is, however, obvious that the authors have been somewhat handicapped by the necessity of steering a middle course between the requirements of their two sets of readers. They have, however, succeeded in producing an interesting volume written in a style which will appeal to all their readers. The book covers the main points of interest and importance to cotton farmers, who will doubtless find it a useful handbook on the subject in which they are most interested—viz., the growing of the crop. In addition, the chapters on the botanical features of cotton, and on cotton breeding, also those on grading and selling, and on local insect pests, contain information not readily obtainable in localities removed from libraries. To the interested outsider the early chapters describing the history and prospects of the industry in South Africa, and Chapter IX. giving temperature and rainfall data, along with a set of excellent meteorological maps, are to be recommended. The excellent chapter on insect pests would have been improved by the addition of a few plates. The book is published by the South Africa Central News Agency, who are to be congratulated on its general style and get-up.

187. The following is a summary of a report received from Mr. Milligan, outlining the scientific work that is being carried on by the Corporation's staff and that deputed by the Union Government.

Plant Breeding.—Hitherto the seed has been badly mixed at the ginneries and there has also been considerable crossing in the fields. The various imported varieties have, however, generally been of superior staple, so that the results are less bad than they might have been. Mr. Parnell's opinion is that single plant selection, coupled with the organization of the whole seed supply, offers the only satisfactory solution of the problem, but as this takes time, mass selection on Improved Bancroft and Zululand Hybrid will meanwhile be carried out as well.

Apart from the purity of seed supply, the chief need in the middle veld is a cotton which will ripen before the frost, and in the low veld a good medium-stapled variety which will resist the jassid as far as possible. The plant-breeding work is therefore being carried on in two districts: in the middle veld at Rustenburg by the Government Plant Breeder, and in the low veld area at Barberton, by Mr. Parnell. Barberton is reasonably free from malaria, and it is the headquarters of a co-operative cotton society, which owns its own ginning plant, and possesses an organization which will prove a useful means of distributing an improved strain on a large scale.

Entomology.—Formerly none of the Government Entomological Staff devoted their whole time to the entomology of cotton. The Chief of the Entomological

Division has, however, kindly co-operated with Mr. Milligan, the staff has been supplemented, and it is hoped to have two, and possibly three, entomologists working on the local pests of cotton, the chief of which are the boll-worms and jassids.

Soil Chemistry.—The yields could be greatly increased if the growers had a wider knowledge of manuring, which is complicated in the Union on account of the great variety of soils and diversity of rainfall. A large number of field experiments, involving careful supervision by experienced officers, are necessary, and Mr. Milligan has succeeded in obtaining a strong team of workers to carry out these experiments, while there will be about ten men to assist in supervising and organizing.

Mr. Milligan reports that this year fifteen men will be working on cotton problems, either whole or part time, as against four last year. These figures alone show the remarkably sympathetic response of the Union Government, and of the technical officers in particular, to the efforts that the Corporation are making to increase and improve the cotton output of South Africa.

188. From a report received from the Department of Agriculture we learn that approximately 67,500 acres have been planted to cotton this season (1924-25). In practically all areas very good rains were experienced, and consequently excellent stands of young, healthy cotton have been obtained. The prospects are, therefore, of the very best, and while it is too early to form valid estimates of the crop, a minimum of 20,000 bales (of 500 pounds each) seems assured. Present conditions indicate a crop of 25,000 bales.

189. We have received the following, issued by the Department of Overseas Trade: "Report on the Economic Conditions of South Africa," July, 1924, by W. G. Wickham. The labour problem is dealt with on pp. 33-35.

190. *The Supply of Cotton Seed for Planting Purposes.* By A. R. Pullen (*Journ. Dept. of Agric., S. Africa*, vol. ix., 1924, pp. 318-323). Discusses the question of the future seed supply of South Africa, pointing out the desirability of one-variety areas, and the necessity for the continual selection of the best seed.

191. *Cotton in South Africa: A Year Book of Progress* (issued by the *Sun and Agric. Journ. of S. Africa*). This bulletin contains articles and interviews relating to cotton cultivation in the Union that have been published during the past year by the *Sun and Agric. Journ. of S. Africa.* There are articles by Mr. R. A. Rouillard on "Cotton Cultivation," and Sir William Hoy on "Railways and the Cotton Industry," also accounts of interviews with Mr. S. Milligan, Mr. P. J. Du Toit, Mr. W. Scherffius, Major P. Greathead, and Mr. A. G. Owen.

192. *Meade Cotton: A very Promising Variety. Selection Work done in South Africa.* By Lloyd Worrall. (*Cott. News Weekly*, vol. i., No. 12, 1924, p. 286).

193. *Lime Requirements of Soil and Plant.* By T. D. Hall. (*Cott. News Weekly*, vol. i., No. 15, 1924, p. 375).

194. *Cotton Progress in Zululand.* (*Cott. News Weekly*, vol. i., No. 18, 1924, p. 460). A report from Zululand says the cotton lands are now veritable hives of industry. Intensive cultivation is the order, and the rains have made it possible to extend the area of cultivation considerably.

(*Cf.* also Abstracts 274-6.)

195. SUDAN. *The Sudan as a Cotton Producer.* An interesting series of articles, commencing in vol. i., No. 1, of *East Africa* and continued in subsequent numbers, dealing with cotton growing in the Sudan, the area under cultivation, methods of cultivation, present production, and the anticipated development in the near future.

(*Cf.* also Abstract 231.)

196. TOGOLAND. (From the *Int. Crop Rep. and Agric. Stats.*, No. 11, 1924, p. 534. Published by the *Int. Inst. of Agric.*, Rome.) Cotton growing by the natives is in process of rapid extension. Several districts have already organized plantations on the communal system, and the clearing of land for further developments is active in some regions. The Government has distributed seed freely both of Togo Sea Island and of Upland varieties.

197. UGANDA. *Industry in Uganda.* By S. Simpson, Director of Agriculture. (*East Africa*, vol. i., No. 2, 1924, p. 40.) In one part of this interesting article the author deals with the type of cotton found, after many experiments, to be most suitable for Uganda soils, the training of natives in ploughing, and the regulations governing the cultivation of cotton.

198. (Extracted from the Annual Report of the Empire Cotton Growing Corporation for 1924.) A report has been received from the Government of Uganda on the use that has been made of the ploughs presented by the Corporation, showing that they have been of very considerable service in extending the area under cotton. The tractor ploughs have been utilized in opening up land at the foot of Mount Elgon, and the land, after having been ploughed and made ready for the crop, has been allotted to natives from the hill tribes in that region who would not otherwise have cultivated any crop in addition to their food. The total area ploughed with these tractors amounted to 780 acres, accommodating approximately 1,500 new producers of cotton on half-acre allotments.

The ox-drawn ploughs were, in the first instance, utilized in the ploughing schools established by the Department of Agriculture for training purposes; as soon as natives had been trained as ploughmen the ploughs were loaned out for work on smallholdings, or were used in carrying out communal ploughing schemes.

(*Cf.* also Abstract 262.)

199. (Abstract from *Afr. Industries*, vol. x., No. 3, 1925, p. 28.) In his speech at the Caledonian dinner at Kampala, Sir Geoffrey Archer made the following statement with regard to transport:

"I now come practically to the last of my subjects—transportation and communications. It will not be surprising if it is found difficult to move, with expedition, the great cotton crop of 1924. The resources of our transport system are now being investigated by a Committee. One thing certain is that there is an urgent and pressing need to carry the railway through, as quickly as may be, not only to Kumi in the north, as sanctioned, but to Lira—to tap the area of enormous production existing to-day and extended to this point and even beyond. Meanwhile, the Uganda Railway authorities are doing much to increase the storage and landing facilities at Port Bell and Jinja in order to reduce congestion."

200. AUSTRALIA. (Abstracted from *Austr. Cott. Grower*, vol. ii., No. 9, 1924, p. 11.) An agreement has been made between the Federal Government and the State whereby guaranteed prices for cotton will again be assured to the cultivators for the current season. Any loss incurred will be equally shared by the Federal Government and the State. The prices for the seven grades of mature cotton range from 5¼d. per pound for "A" grade to 3½d. for "G" grade. For the three grades of immature cotton the prices guaranteed are 4¾d., 4½d., and 3½d. per pound. Ratoon cotton is excluded from the guarantee.

201. QUEENSLAND. *Programme of Experimental Work for the* 1924-5 *Cotton Season.* The spring rains have been excellent, and the outlook is promising. About 11,000 acres are under Durango, 40,000 to 50,000 under the ordinary mixed seed, and possibly 20,000 acres of ratoon. Many of the farmers have profited by the advice given, and prepared their land early, and thus obtained a good strike at the right time.

The whole of the Durango seed has been treated in the Simons Heater, which has been erected at Whinstanes, to destroy pink boll worm larvæ, and has been issued for planting in one-variety community blocks.

The programme of experimental work that is being undertaken this season by Mr. Evans and his staff is as follows:

Acala is being given a fairly extensive trial on about 50 acres on the Agricultural College farms at Galton. In the selection work done last season a number of progenies was obtained with a staple of $1\frac{3}{16}$ inches, and it is slightly earlier than Durango. Webber 49 and Delta type are being grown on plots in Government House grounds, Brisbane. These selections are promising, and are giving cotton of 1¼ inches staple. Lonestar is being tried in two places, but its staple at present is not more than 1⅛ inches, and Mr. Evans has decided not to liberate any seed until he has bred something better from it. A number of selections of Durango are being tried; this is the stock variety, and is the only pure type that has as yet been distributed. Mr. Evans is aiming at the production of a staple of $1\frac{3}{16}$ inches and a type of plant with a small leaf and open habit of growth to suit local conditions.

In addition to these selection tests and varietal trials, a number of experiments are being carried out on the different farms, on fertilizers, on the effect of spacing, time of thinning, etc., and the entomologists are working in close co-operation.

202. VICTORIA. *Cotton Growing Experiments.* By C. J. R. Johnston (*J. of Agr., Vict.*, vol. xxii., 1924, p. 688.) The yields of cotton from the experimental plots were, apparently on account of the unusual seasonal conditions, very low, and only a proportion of the crop harvested comprised first quality seed cotton. The highest yield obtained was 300 pounds per acre—this from the early variety Acala.

It would appear from the result of these experiments that cotton growing on a large scale in districts comparable to Wahgunyah is not at present warranted, but that there is some possibility of it becoming, by the introduction of early maturing varieties and judicious control of watering, a useful side-line to the Murray Valley farmer.

COTTON IN THE UNITED STATES.

203. We have received a copy of the "Report on the Finance, Industry, and Commerce of the United States of America," dated April, 1924 (J. Joyce Broderick), issued by the Department of Overseas Trade.

Cotton is dealt with on pp. 53 to 56. The consumption of Pima cotton is on the increase, as the following figures show:

1920-21	16,826 bales.
1921-22	47,546 „
1922-23	65,126 „

204. THE AMERICAN COTTON CROP, 1924. By Arno S. Pearse. (*Int. Cott. Bull.*, vol. iii., 1924, pp. 2-19; 176-177.)

205. COTTON GROWING. By W. H. Sachs et al. (*Ark. Agr. Col. Ext. Circ.*, 160, 1924. Abstr. in *Exp. Sta. Rec.*, **51**, 6, 1924, p. 599.)

206. BOLL STUDIES WITH UPLAND COTTON. By W. E. Bryan and E. H. Pressley. (Abstr. in *Exp. Sta. Rec.*, **51**, **6**, 1924, p. 531.)

207. GROWING UPLAND COTTON IN ARIZONA. By G. E. Thompson and E. H. Pressley. (*Exp. Sta. Rec.*, vol. li., 1924, p. 532.) Practical information on the varieties, cultural and field practices, and methods of pest control involved in the production of Upland cotton in Arizona.

208. COTTON CULTIVATION IN ARIZONA. By R. S. Hawkins, S. P. Clark, I. A. Briggs, and B. J. Showers. (Ariz. Sta. *Timely Hints for Farmers*, 145, 1924. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 21, 1924, E. 80.)

209. COTTON CULTIVATION IN GEORGIA. (*Georgia Sta. Rept.*, 1923, pp. 39-44 and 49. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 18, 1924, E. 48.) Applications of sodium nitrate and ammonium sulphate at planting time resulted in higher yields than those of later applications. Clay loam cotton land was benefited by the addition of limestone, and raw phosphates again demonstrated considerable value as a source of phosphorus for cotton.

210. COTTON VARIETY TESTS IN MISSISSIPPI. By J. F. O'Kelly and R. Cowart (*Miss. Sta. Bull.*, 1923, No. 219, 3-12. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 17, 1924, E. 42.) Cook with 382 pounds of lint per acre, and Cleveland with 375 pounds averaged highest in five years' tests at the Mississippi station, while Delfos and Trice led in acre value. Trice, Triumph, and Delfos 6102 led the standard cotton varieties in 1923, and Trice, Cleveland strains and Lone Star 65 were foremost on hill land. Cleveland x Lewis 63, Cook 307-6, and Cleveland 54 gave the most valuable crops on wilt-infested soil. Sodium nitrate and ammonium sulphate have shown the highest net gains in tests of nitrogenous fertilisers. The optimum time for applying sodium nitrate appears to be after hoeing. A co-operative experiment in boll weevil control by the calcium arsenate method is reported.

211. COTTON CULTIVATION IN TENNESSEE. By C. A. Mooers and S. A. Robert. (*Tennessee Sta. Bull.* 127, 1923, and *Tenn. Agr. Col. Pub.* 117, 1923. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 13, 1924, E. 31.)

212. COTTON CULTIVATION IN WEST TEXAS. (*Cotton News*, 1924, **3**, No. 46. p. 6. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 17, 1924, E. 43.)

(*Cf.* also Abstracts 244-5, 248-51, 264-5.)

213. COTTON MILLS: POWER COSTS IN U.S.A. (Abstr. in *J. Text. Inst.*, vol. xv., No. 12, 1924, A. 348.)

COTTON IN EGYPT.

214. EGYPT. We have received from the Department of Overseas Trade the "Report on the Economic and Financial Situation of Egypt," April, 1924, by E. Homan Mulock. The report contains articles upon Movement of the Cotton Crop, Cotton Prices, Sakel *v.* Uppers, and a discussion of the causes (chiefly economic) that have led to the increasing substitution of Uppers for Sakel in Lower Egypt. Other articles deal with Yield and Acreage, and with Government Policy.

215. *Egyptian Cotton Crops and Prices.* By J. A. Todd. (*The Near East*, Jan. 15, 1925, p. 71.)

216. *Cotton Cultivation in Egypt.* By Ernst Schultze. (*Leipziger Monats. Text.-Ind.*, 38, 1924. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 13, 1924, E. 31.)

217. *Cotton Plant: Spacing.* By J. A. Prescott. (*Bull.* No. 13, *Sultanic Agr. Soc., Tech. Sec.* Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 20, 1924, E. 72.)

218. *The Effect of Water on the Cotton Plant.* By J. A. Prescott. (*Bull.* No. 14. *Sultanic Agr. Soc., Tech. Sec.* Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 20, 1924, E. 72.)

(*Cf.* also Abstracts 246, 252.)

COTTON IN FOREIGN COUNTRIES.

219. COTTON CULTIVATION IN CHINA. (*Manch. Guard. Com.*, Nov. 27, 1924.)

220. COTTON CULTIVATION IN CHINA. (*Text. Rec.*, 1924, **42**, No. 498, 51-52. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 17, 1924, E. 40.) There are six cotton mills in Tientsin, having a total of 210,000 spindles, of which only 147,500 are now operating owing to trade depression. The best-known variety of cotton produced in the hinterland of Tientsin is the Yu Ho cotton, which is produced in the south-eastern part of Chihli Province and north-western part of Shantung. Yu Ho cotton is soft and white, and its average staple length is between 0·85 and 0·87 inches. Hsi Ho cotton is produced in parts of Chihli and Honan, especially in the Hsi Ho valley. Generally speaking, this variety is inferior to Yu Ho, but under favourable conditions it produces longer staple. The quality of Shensi cotton, produced in the Province of Shensi, is superior to that of other native varieties. Tung Ho cotton is an important commodity on the Tientsin market. That produced near Fangjun is known in Tientsin as Hsiao Chi, whilst that produced in the neighbourhood of Yangtsun is known by the name of the district. In recent years shipments of Turfan cotton produced in Chinese Turkestan have reached the Tientsin markets.

221. COTTON CULTIVATION IN CHINA. (*L'avenir text.*, 1924, **6**, 388-391. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 17, 1924, E. 40.) A review of the conditions of cultivation and manufacture in China. Cotton is cultivated over extensive areas, and it is stated that China is the third largest cotton-producing country in the world. The valley of the Yangtse-Kiang is the principal centre of cultivation. The work is done by tenant-proprietors who generally cultivate small areas and pay little attention to methods for preserving staple. The quality of the cotton varies considerably. The best product is obtained in the Tungchow and Tsonguing districts, and its staple length is 22 mm. Very little Chinese cotton has a staple length of 25 mm., but it is distinguished by its whiteness. Cutworm, a species of lepidoptera, anthracnose, mosaic, and angular leaf spot are encountered. Attempts are being made to improve the quality of the cotton produced by introducing American Upland seed. The bulk of the crop is absorbed by the home spinning and weaving industries of China. There are, however, a number of mills, especially around Shanghai. In these mills American cotton is worked in with the native product. The author points out that, owing to the lack of statistics, it is at present impossible to arrive at an accurate estimate of the extent of cotton cultivation and manufacture in China.

222. COTTON CULTIVATION IN ARGENTINA. (From the French Commercial Attaché in Argentina.) (*L'avenir textile*, 1924, **6**, No. 11. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 21, 1924, E. 74.)

223. COTTON CULTIVATION IN THE ARGENTINE. (*Text. Mercury*, 71, 1924, 94. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 14, E. 34, 1924.)

224. COTTON GROWING IN THE ARGENTINE. (*Int. Cott. Bull.*, vol. iii., No. 9, 1924, pp. 163-166.)

225. COTTON GROWING IN THE ARGENTINE REPUBLIC. From the Report of the Central Argentine Railway for the year ended June 30, 1924, we extract the following:

The shortage in the world supply of cotton, with the consequent rise in the prices paid for it, has resulted in extensive areas in the northern regions of the country being planted with the textile, the prospective production for 1924 being calculated at 47,000 bales of ginned cotton, of which some 33,000 would be available for export.

The Argentine cotton zone embraces practically the whole of the northern regions of the country, and the climate and soil are stated to be peculiarly favourable for the cultivation of the textile. The increase in the area put under cotton is shown by the following table:

Agricultural Year.	*Hectares.*
1914–15	3,300
1917–18	11,780
1919–20	13,360
1922–23	23,500
1923–24	62,700

226. COTTON GROWING IN BRAZIL. By Dr. P. de M. Barros. (*Int. Cott. Bull.*, vol. iii., No. 9, 1924, pp. 20-43; vol. iii., No. 10, 1924, pp. 200-208.)

227. COTTON MARKETING: BRAZIL. (*Leipzig Woch. Text. Ind.*, 1924, **39**, 953. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 20, 1924, E. 65.) Projects are afoot to make Havre the main commercial centre in Europe for Brazilian cotton. At the present time only 4 per cent. of the exports is sent direct to France, 8 per cent. to Portugal, and 73 per cent. is sold in the Liverpool market.

228. PERU. We have received from the editor of the *West Coast Leader*, Peru, a copy of the Annual Cotton Number containing, among others, a very interesting article dealing with the varieties of Peruvian cotton, methods of cultivation, labour conditions, injurious pests and diseases, etc.

CULTIVATION AND MACHINERY: IRRIGATION, ETC.

229. COTTON CULTURE IN SOUTHERN RHODESIA. By D. D. Brown. (*Rhod. Agr. J.*, vol. xxi., 1924, p. 530.) From the above instructive article we extract the following:

Selection of Seed.—Before a general move is made with the first picking, it is as well to first go over the field and select plants from which to save seed for next season's planting. A distinctive mark should be placed upon those plants selected, and the seed taken from them carefully set aside until sent to be ginned, and returned as special planting seed. In selecting these plants the following are the principal points to look for:

(*a*) Early maturity.
(*b*) Type of plant.
(*c*) Size and shape of boll.
(*d*) Quality of lint.
(*e*) Yield of seed cotton.

Early maturity is an important point, and plants combining early ripening along with other desirable features should be selected for seed.

The cotton plant produces two kinds of branches—vegetative and fruiting, and plants well endowed with the latter will produce more fruit. It is desirable to have the nodes closely set along the length of the fruiting branch. The number and size of bolls will influence the yield of cotton.

The size and shape of the bolls are next considered. Those bolls coming to a sharp-pointed end usually produce a longer and finer lint than the snub or round-ended bolls. To find out the quality of the lint the bolls should be examined when the cotton is ripe. If the lint is found to be of suitable length—1⅛ to $1\frac{3}{16}$ inches or a trifle longer—strength, and evenness, this seed cotton should be carefully set aside, and when ginned the seed should be used for next season's planting.

The above method is easily carried out by any cotton grower, and will help in increasing the yield and quality of the cotton crop. A still better system is outlined in the following diagram prepared by Dr. H. J. Webber:

	1st Year.	*2nd Year.*	*3rd Year.*	*4th Year.*	*5th Year.*
Select plant	(1)	500 plants.	5 acres	General crop.	—
	Select plant	(1)	500 plants.	5 acres.	General crop
		Select plant	(1)	500 plants.	5 acres
			Select plant	(1)	500 plants
				Select plant	(1)

A start is made by the selection of one or more plants which conform to the desired ideal. The seed produced from these plants is saved, and the following season is planted in a small patch away from the main crop. The seed from each selected plant should produce 500 plants. From the progeny of that selected plant proving most satisfactory a further selection of one or more plants is made. The seed from these is kept and planted separately, and the remainder of the plants will furnish sufficient seed to plant a seed plot of five acres. The seed obtained from this five-acre seed plot is used for planting the main crop the following year.

At the end of the fourth year by this method the breeder will have a single select plant, a plot of 500 selected plants, a five-acre plot of selected plants, and a general crop grown from selected seed. By consistently following out this system a cotton of high excellence can be evolved and maintained.

230. Manuring for Cotton Production. By G. N. Blackshaw. (*Rhod. Agr. J.*, vol. xxi., 1924, pp. 539-542.) This paper refers to manuring of the soils of Southern Rhodesia, and ends with a table of hints from which we may quote the following:

The proper time to start preparing the land for cotton is during the season before the crop is to be planted.

Cotton seed is inexpensive, therefore only the best, and enough of it, should be used for planting; anything else is poor economy.

By machine 25 pounds and by hand 20 pounds of seed will plant 1 acre of cotton.

Planting seed of only one variety of cotton will aid in establishing a degree of uniformity unattainable when a host of varieties of cotton is grown.

Cotton requires a long growing season, therefore the first possible chance should be taken to plant the seed.

Cultivate the crop early and as often as necessary to keep a soil mulch.

When plants are 10 inches high a cultivation deeper than 3 inches is detrimental to the crop.

Cotton should be graded before being delivered to the ginnery.

231. Composition of Sudan Soils. By A. F. Joseph (*J. Agr. Sci.*, 1924, **14**, 490-497. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 21, 1924, E. 82.) A description is given of five typical soils of the Sudan, covering a wide area. They include "badob," or cotton soil principally found in the Gezira. It is a heavy brown soil of æolian origin, characterized by a high proportion of clay and a low one of silt, and little tendency to drain. All the soils examined are alkaline and, with one exception, low in calcium carbonate. The results of the full chemical analysis of the conventional fractions are given, and it is suggested that an important characteristic of a clay soil is the chemical composition of the clay fractions.

232. COTTON SEED: GERMINATION TESTS. By E. H. Toole and P. L. Drummond. (*J. Agr. Res.*, 1924, **28**, 285-291. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 18, 1924, A. 46.) Variations in the results of germination tests on cotton seed are discussed, and it is shown that in cotton seed there are three distinct classes of samples: (1) Strong samples, in which a large percentage of the seeds will germinate well under a wide range of conditions. (2) Samples which contain many dead or weak seeds which always fail to produce healthy seedlings. (3) "Sensitive" samples, in which a large percentage of the seeds are viable and capable of producing seedlings, although there is a tendency for the seeds to succumb under unfavourable conditions of germination. The first two classes offer no difficulties in testing, but when sensitive samples are germinated, the entire test is often covered by a growth of fungus, many of the young sprouts are water-soaked and decayed, and in many of the remaining seeds the hypocotyl decays before it has a chance to break through the seed coat. The mould and decay are due to the seeds themselves. Sensitive samples are not the result of "heating" in storage. Excessive moulding is not dependent on the temperature of germination. Methods of demonstrating live seeds in sensitive samples are described.

233. COTTON PLANTS: SPACING. By R. Swami Rao. (*Bot. Abstr.*, 1924, **13**, 708. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 18, 1924, E. 50.) Differences in the sowing and spacing of cotton as adopted in two adjacent districts of the Madras Presidency, differing only with regard to rainfall, are pointed out, with a statement of the results obtained in three different places.

234. HOW TO GROW UPLAND COTTON. (*Bull. Univ. Arizona ; Austr. Cott. Grower*, vol. ii., No. 8, 1924, p. 17.)

235. CAMBODIA COTTON : CULTIVATION. (*L'avenir Textile*, 1924, **6**, No. 11. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 21, 1924, E. 74.)

236. CULTIVATION OF AKALA COTTON. By A. S. Pearse. (*Int. Cott. Bull.*, 1924, **3**, No. 9, p. 7. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 19, 1924, E. 54.) Akala has almost entirely replaced Pima in Arizona and California, and has expanded a good deal in Texas. Under favourable conditions its staple is 1⅛ inches, so that it may prove suitable as a substitute for Upper Egyptian. This competitive element would tend to restore longer staple to its old predominance in Lower Egypt.

237. COTTON FERTILIZATION. (*Austr. Cott. Grower*, vol. ii., No. 6, 1924, p. 38.)

238. THE AGRICULTURAL ASPECT OF COTTON: NOTES ON PREPARING THE SOIL AND SEED BED, PLANTING, AND ROTATION CROPS. By W. B. Remley. (*Cott. News Weekly*, vol. i., No. 19, 1924, p. 493.)

239. GETTING A GOOD STAND OF COTTON. By J. D. Young. (*Austr. Cott. Grower*, vol. ii., No. 8, 1924, p. 18.)

240. COTTON HAIR: FACTORS AFFECTING LENGTH. By T. H. Kearney. (*J. Agr. Res.*, 1924, **28**, 563-565. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 20, 1924, A. 52.) To elucidate the common belief that in long-staple cotton the first pickings are shorter than later ones, measurements have been made of the length of the hairs on one seed from a ripe boll from each successive fruiting branch on ten well-grown plants of Pima cotton grown under irrigation in Arizona. It is concluded that bolls borne on the lower fruiting branches, constituting the so-called "bottom crop," produce shorter fibre than bolls that are situated higher on the plant. Measurements were also made to ascertain whether there is a consistent relation between hair length and date of opening of the flower from which the boll developed. The data obtained were insufficient to make generalization safe, but the results point to the conclusion that hair length is affected less by the date of flowering than by the height on the plant of the fruiting branch on which the boll is borne.

241. COTTON GIN: DESCRIPTION. Platt Bros. and Co., Ltd. I. Leech and T. H. Bradley. (Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 15, 1924, E. 39.)

242. A GINNERY PROBLEM: SAW-GIN *v.* ROLLER-GIN. By E. R. S. Cheales. (*Cott. News Weekly*, vol. i., No. 19, 1924, p. 496.)

(*Cf.* also many Abstracts under Cotton in India, Empire, etc.)

DISEASES, PESTS, AND INJURIES, AND THEIR TREATMENT.

243. INSECTICIDES, FUNGICIDES. By C. C. McDonnell. (*Ind. Eng. Chem.*, 1924, **18**, 1007-1012. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 18, 1924, A. 47.) Important recent advances in the manufacture and application of insecticides and fungicides are reviewed. The insecticides discussed include arsenic compounds, oil emulsions, plant insecticides such as nicotine, pyrethrum, derris, larkspur, and "cube," and organic compounds such as pyridine and α-picoline. Hydrocyanic acid, calcium cyanide, ethyl acetate, and carbon tetrachloride are efficient fumigants. The principal fungicides are copper compounds, mercury compounds, and sulphur and lime-sulphur solution. Calcium caseinate, soap, saponin, glue, and flour paste have been tried as spreading and adhesive agents. A bibliography of 132 references is appended.

244. CONTROL OF COTTON PLANT DISEASES IN U.S.A. (*Amer. Fertiliser*, 1924, **60**, 21-22. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 19, 1924, E. 61.) In connection with cotton production in 1924 the following recommendations were adopted by the Cotton Council of the Association of Southern Agricultural Workers. In soil infected with the cotton wilt fungus, *Fusarium vasinfectum*, good seed of the highly resistant varieties—Dixie Triumph, Toole, and Lewis 63—should be planted. Where root knot, *Heterodera radicola*, and wilt are both present, a three-year rotation, which may include maize, small grains, peanuts, velvet beans, and Brabham or iron cowpeas, should be practised, followed by the cultivation of wilt-resistant varieties. A two-year rotation and the use of disease-free seed are recommended for the control of anthracnose, *Glomerella gossypii*, and delinting the seed with sulphuric acid for that of angular leaf spot, black arm, and bacterial boll rot, all caused by *Bacterium malvacearum*.

245. COTTON DISEASES AND THEIR CONTROL. By W. W. Gilbert. (*Bull. U.S. Dept. of Agr.* Abstr. from *Cott. News Weekly*, vol. i., No. 21, 1924, and following number.) The diseases dealt with in this article include cotton wilt, root-knot, anthracnose, bacterial blight, shedding of bolls, rust, sore-shin, Texas root-rot, leaf-spot, leaf-blight, areolate mildew, true rust, diplodia boll-rot, and fusarium boll-rot.

246. CONTROL OF COTTON PLANT DISEASES IN EGYPT. By Karl Snell. (*Angew. Botanik*, 1923, **5**, 121-6. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 21, 1924, E. 81.)

247. THE CONTROL OF COTTON PESTS IN NORTH INDIA. By P. B. Richards. (Abstr. from *Agr. J. India*, vol. xix., 1924, pp. 568-578.) This article, which is well illustrated, deals with the spotted boll worms and the pink boll worm.

248. EFFECT OF BOLL WEEVIL ON COTTON CROP. By J. A. Becker. (*Int. Cott. Bull.*, 1924, **2**, No. 8, 519-525. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 19, 1924, E. 54.)

249. APPROVED AND RECOMMENDED METHOD FOR COMBATING THE BOLL WEEVIL FOR 1924, AND FACTS RELATIVE TO THE BOLL WEEVIL'S LIFE HISTORY. By C. E. Sanbern and G. Briggs. (*Okla. Agr. Col. Ext. Cir.*, 1923, 193. Abstr. in *Exp. Sta. Rec.*, **51**, 6, 1924, p. 554.)

250. "TEXACO B.Q." APPLICATION. By A. S. Pearse. (*Int. Cott. Bull.*, 1924, **3**, No. 9, p. 12. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 19, 1924, E. 64.) This is a new boll weevil repellant consisting mainly of Texas petroleum, which resists rain and does not damage the plant, but kills the weevil and acts on its eggs. For its application a special mechanical sprayer has been devised by the International Harvester Company.

251. CALCIUM ARSENATE: TOXICITY. By C. M. Smith. (*J. Agr. Res.*, 1923, **26**, 191-194. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 22, 1924, E. 83.) Dew on Upland cotton plants contains large quantities of salts which, in laboratory tests, so act upon calcium arsenate as to increase greatly the water-soluble arsenic content. Excretions from leaves, therefore, must be considered as a factor in explaining arsenical injury to plants.

252. STATISTICS OF PINK BOLL WORM OCCURRENCE FROM 1916 TO 1922. (*Egypt. Min. Agr. Tech. and Sci. Serv. Bull.* 27 (1923). Extr. from *Exp. Sta. Rec.*, **51**, 7, 1924, p. 661.) Statistical data, here presented in tabular form, and based upon summer collections during the past seven years, give the distribution of the pink boll worm in time and place in Egypt.

253. THE TREATMENT OF SMALL BATCHES OF COTTON SEED AGAINST PINK BOLL WORM. By Owen B. Lean, B.Sc. An account of experiments carried out at the Imperial College of Science and Technology, with a view to determining (1) at what temperature, and for how long, cotton seed may be safely treated without endangering germination; and (2) what temperature is required to kill any insects that might be present in the seed.

The results of the experiments showed (1) that seed may be heated for as long as twenty-eight hours at a temperature of 57·5° C. without very much falling off in germination; and (2) that heating the seed for ninety minutes in an anhydric oven working at 60·0° C. will ensure the death of all insect life, and will not damage the germinating power of the seed.

254. PINK BOLL WORM: CONTROL. By R. E. McDonald and G. J. Scholl. (*Texas Dept. Agr. Bull.* 71, 1922. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 13, 1924, E. 32.) In connection with the disinfection of cotton seed, to prevent the spread of the pink boll worm, experiments on the thermal death point of the pest and the temperature injurious to the germination of the cotton seed are reported upon. All seed masses must be broken up and each individual seed come in contact with the heating medium if the heat treatment is to be effective. Cotton seed uniformly heated to 145° F. with 3·5 minutes' exposure will be rendered free of living pink boll worms. Cotton seed may be heated to 165° without injury to germination. Disinfecting machinery should be equipped with reliable heat control apparatus and a good recording thermometer.

255. CONTROL OF THE PINK BOLL WORM ON COTTON. (*Austr. Cott. Grower*, vol. ii., No. 8, 1924, p. 21.)

256. PINK BOLL WORM DISTRIBUTION IN PORTO RICO. By G. N. Wolcott. (*Porto Rico Dept. Agr. and Labor, Sta. Circ.*, 85, 1923. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 13, 1924, E. 33.) The author reports upon a second survey made during the winter and spring of 1922-1923 and conducted with a view to determining the effect of the continued presence of a few cotton plants as compared with destruction, the direction of the wind, and the climatic differences of the north and south sides of the island upon the spread of this pest. The survey has shown the entire north coast, except in a few places, to be infested by pink boll worm. It was found that normal dispersion by flight is wider from commercial plantings of cotton than from scattered wild plants, that flight is to some extent aided by winds, and is almost, if not entirely, prevented by arid or semi-arid conditions. It was found that 20 per cent. of the larvæ collected from January to April have a resting-stage averaging 128 days, the maximum period being 185 and the minimum 42 days. This permits some of the moths to emerge in June, July, and August rather than from February to April, the period for about 80 per cent. of them. None of the larvæ collected in September and October had a resting period, but all transformed to pupæ and adults emerged in October and November.

257. CONTROLLING COTTON BOLL WORMS. (Abstr. from *J. Dept. Agr., S. Africa*, vol. ix., 1924, p. 312.) The following measures for the control of cotton boll worm are recommended by the Division of Entomology:

1. Choose soils of a sandy-loam texture that will work up loosely and not leave hard lumps. Generally, such soils give less trouble from boll worm. Exceptions may be due to combinations of crops, surroundings, poor culture, ratooning, etc.
2. Early in the winter, if possible before the middle of August, the cotton lands should be cleared of the old plants, and the soil broken to a depth of at least 5 inches, so as to leave no large lumps. Ploughing, followed by one or two diskings, may be sufficient, but if the soil is too hard, the land should be cross-worked with a heavy weighted disk, and subsequently further prepared for seeding in the spring. For the efficient control of boll worms and other soil insects it is essential that the lands be treated in this way, and left under bare fallow through the winter. Old maize lands should be treated the same way.
3. For healthy, vigorous plants good seed, fertile soil, and early planting are useful aids.
4. Cultivation of the growing crop will not in itself control boll worm, but is a useful aid, as it invigorates the plants, and tends to destroy some of the boll worm chrysalids in the soil.
5. As ratooning allows the boll worms to increase unchecked, it should not be practised.
6. No cotton plants should be allowed to grow outside the cotton fields; as far as practicable destroy all nearby plants belonging to the cotton family, also any plants found harbouring boll worms.

258. RED BOLL WORM IN UGANDA (?). We have received the following letter from the Director of Agriculture, Uganda:

"I have the honour to inform you that the first paragraph on page 202 in your issue Vol. I., No. 3, July, 1924, on 'Insect Pests of Cotton,' in which Uganda is mentioned, has been brought to the notice of the Entomologist here, who replies as follows:

> '"With reference to the report on page 202 of the *Empire Cotton Growing Review*, I. (1924), on the occurrence in Uganda of *D. castanea* Hmps. (red boll worm), I have the honour to state that I possess no record of the insect in Uganda.
>
> "'The red boll worm noticed last year for the first time was submitted for identification to the Imperial Bureau of Entomology, but its name has not yet been received. Judging from descriptions and figures of the above-named pests, I am of opinion that it is not the same as our red boll worm.
>
> "'I notice that a South African bulletin also records *D. castanea* as a serious pest of cotton in Uganda, and I am unable to explain how these mistaken records have been made. Possibly Professor Lefroy's statement is based on the South African bulletin.'"

The letter was referred to Professor Maxwell Lefroy, who informs us that the statement was based upon Entomological Bulletin No. 6, entitled "The Sudan Cotton Boll Worm," by H. H. King.

259. CONTROL OF COTTON WILT IN INDIA (BOMBAY AND CENTRAL PROVINCES). By W. McRae. (*Ann. Rept. Bd. Scientific Advice, India*, 1922-23, pp. 31-35. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 19, 1924, E. 62.) Further experiments on varietal resistance to cotton wilt have been made in Bombay, inoculations being made both in the field and in pots. Of 431 plants of Wagale, 4 per cent. were wilted; of 414 plants of Dharwar 2, 30 per cent. were wilted; and of 419 plants of Kumta, 39 per cent. The incidence of disease in the other varieties tested ranged from 56 to 83 per cent. In the F_1 generation of a cross between Dharwar 1 and a pure, wilt-resistant strain of Wagale, resistance was found to be dominant, at any rate during the greater part of the growing period. The results of pot experiments showed that the variety Broach Deshi Plant 6 is completely immune from wilt. Negative results were obtained in the Central Provinces from inoculation experiments on healthy cotton plants with cultures of species of *Fusarium* and *Cephalosporium* isolated from wilted stems and roots.

260. COTTON WILT DISEASE. (Abstr. from *J. Dept. Agr.*, *S. Africa*, vol. ix., 1924, p. 3.) This disease has caused a certain amount of damage in South Africa, and growers are warned to keep a look-out for its presence in their crops. The disease is due to the fungus *Fusarium vasinfectum*, and may be recognized by the yellowing of the leaves from the bottom upwards, a stunting of the plants, followed usually by wilting and death of the whole plant, and the darkening of the fibro-vascular bundles, recognized, on cutting through the stem, as a brown or black ring. The disease is worse on sandy soils, and wet seasons are particularly favourable to its development.

Control consists in practising crop rotation, in pulling and burning diseased plants, and in cultivating wilt resistant varieties.

261. DISEASES OF COTTON IN SOUTHERN RHODESIA. By F. Eyles. (Abstr. from *Rhod. Agr. J.*, vol. xxi., 1924, p. 592.) The following diseases are recorded, and hints given as to their treatment or prevention:

Angular Leaf Spot (*Pseudomonas malvacearum*, Erw. Sm.).
Anthracnose (*Colletotrichum gossypii*, South.).
Boll Rot I. (*Bacillus gossypini*, Stedm.).
Boll Rot II. (bacterial).
Black Rust (*Macrosporium nigricanthium*, Atk.).
Stem Rot (*Cladosporium herbarum*, Lk.).
Yellow Leaf (a form of chlorosis).
Boll Shedding.

262. COTTON PEST: UGANDA. By W. Small (*Rev. Appl. Mycol.*, 1924, **3**, 509 Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 17, 1924, E. 43.) Mature leaves of cotton were severely attacked by *Ramularia areola* during the wet weather of 1922.

263. ANOTHER FUNGUS ATTACKING COTTON (*Sclerotinia sp.*). By W. A. Birmingham. (*Agr. Gaz. New South Wales*, vol. xxxv., 1924, p. 797.)

264. THE ASCOCHYTA BLIGHT OF COTTON. By J. A. Elliott. (Extr. from *Exp. Sta. Rec.*, **51**, 6, 1924, p. 544.) A blight of cotton attributed to *A. gossypii* was reported in west central Arkansas in 1920 and 1921.

265. THE COTTON FLEA IN TEXAS. By A. S. Pearse. (*Int. Cott. Bull.*, 1924, **3**, 9. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 19, 1924, E. 61.) The cotton flea periodically becomes a pest in South Texas. The injured plants grow very tall, put out few lateral branches, and bear scarcely any bolls. The flea also lives on many weeds, and is believed to carry disease germs, but its life history has not yet been worked out.

266. "CRAZY-TOP" (ACROMANIA) DISEASE. By O. F. Cook. (*J. Agr. Res.*, 1924, **28**, 803-827. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 21, 1924, E. 81.)

267. COTTON PLANT TERMINAL BUD: ABORTION. By T. H. Kearney. (*J. Agr. Res.*, 1924, **28**, 1041-1042. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 22, 1924, E. 84.)

268. THE LOCUST CAMPAIGN FOR 1924-25. (*J. Dept. Agr., S. Africa*, vol. ix., No. 5, 1924, pp. 443-447.)

269. THE TSETSE-FLY MENACE IN TROPICAL AFRICA. By Major A. G. Church, D.S.O., M.C. (Member of the East African Parliamentary Commission). (Abstr. from *Nature*, January 31, 1925, p. 160.) The paper points out that the "fly" areas are increasing, and that the diseases carried by the fly are a menace to industry, and urges an organized joint campaign of the various countries of tropical Africa to combat it. It also describes the results of the work of Mr. Swynnerton, Chief Game Ranger in Tanganyika Territory.

BREEDING.

270. INHERITANCE OF PETAL SPOT IN PIMA COTTON. By T. H. Kearney. (*J. Agr. Res.* (*U.S.*), **27**, 1924, No. 7. Abstr. from *Exp. Sta. Rec.*, vol. li., No. 5, 1924, p. 429.) A conspicuous red spot near the base of the petal characterizes Sea Island and Egyptian cottons, while the petals of most Upland varieties are spotless. In a hybrid between Holdon Upland cotton and Pima Egyptian this character showed unifactorial segregation, the ratio of spotted to spotless plants in F_2 being about 3:1. Two plants discovered in 1917 in a field of Pima cotton at Sacaton, Arizona, gave rise to families breeding true for a spotless or very faintly spotted petal.

Observations on several generations of crosses between these families and an inbred family in which the spot is fully developed gave conclusive proof that the spotless or very faintly spotted condition is a simple recessive. Full spotted, however, is not completely dominant, and the heterozygotes are partly distinguishable. The existence of modifiers is not apparent. The degree of expression of the petal spot was found correlated positively and significantly with size of flower in both spotted and spotless populations. However, no evidence of linkage appeared. The spot is affected by the environment, being responsive to soil variations and to seasonal changes. There is an entire absence of linkage between spotless petal and a relatively high mean number of boll-locks, and the spotless condition has been observed only in the two families described.

The possession of such a character as spotless petal by an agriculturally valuable strain of Pima cotton is considered of use in protecting the purity of the seed by making it easy to detect the offspring of accidental cross-pollinations with other strains. Since this character behaves as a simple Mendelian recessive, it probably can be transferred without great difficulty to any desirable strain of Pima cotton.

271. THE CYTOLOGY OF THE COTTON PLANT: I. MICROSPORE FORMATION IN SEA ISLAND COTTON. II. CHROMOSOME NUMBERS OF OLD AND NEW WORLD COTTONS. By H. J. Denham. (Abstr. from *J. Text. Inst.*, vol. xv., 1924, A. 310.) The chromosome numbers have been counted in some thirty-two varieties of cotton, including American, Sea Island, Egyptian, Indian, and Chinese types, and American grown in India. These numbers fall into groups of twenty-six and thirteen chromosomes, the former comprising the cottons of the New World and Egypt, and the latter those of Asia. This may, perhaps, explain the impossibility of crossing American or Egyptian cottons with the Indian types, and suggests a possible solution of the difficulties with the help of cytology.

272. Selective Fertilization in Cotton. **By T. H. Kearney and G. J. Harrison** (*J. Agr. Res.* (*U.S.*), **27**, 1924, No. 6. Extr. from *Exp. Sta. Rec.*, vol. li., No. 5, 1924, p. 437.) Experiments carried on at the Co-operative Testing Station at Sacaton, Arizona, involving Pima Egyptian cotton and Lone Star and Acala, Upland varieties, gave evidence that selective fertilization occurs in both types, and in about the same degree. Nearly 75 per cent. of the ovules on the average are fertilized by pollen of the same type and variety when pollen of the other type is present on the stigmas simultaneously and in about equal quantity. It is held that this evidence of pronounced selective fertilization should be considered in connection with the data given earlier (*Exp. Sta. Rec.*, vol. xlix., p. 226), that as a rule most of the pollen grains reaching the cotton stigmas are originated in the same flower—*i.e.*, there is usually present on the stigmas an excess of self-pollen over foreign pollen. These findings are thought to explain satisfactorily the fact that self-fertilization predominates in cotton, although the flower is well adapted to cross-pollination. The only hypothesis seeming to fit the observed facts is that the presence of like pollen in some way prevents the germination or subsequent development of many of the unlike pollen grains when both kinds are present on the stigmas.

273. The Origin of Tanguis Cotton. (*Text. Rec.*, 1924, **42**, 496, 52. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 14, 1924, E. 36.)

(*Cf.* also Abstracts under Cotton in India, Empire, U.S., etc.)

CO-OPERATION.

274. Co-operation in South Africa. (*Journ. Dept. of Agr., S. Africa*, 1923, vol. vii., No. 6., p. 573.)

Extension of Movement.—A great impetus was given the movement last year, when the Act regulating the formation, registration, and management of co-operative societies and companies came into force. The agricultural community had long awaited new co-operative legislation, and coming as it did at a period when the artificial stimulus of the War had died away, and farmers were facing the fact that their produce was all but unsaleable, the new Act received the closest attention throughout the Union. The position in many districts was desperate. Despite natural advantages, cheap labour, and cheap land, the country's wasteful system of marketing placed it at a disadvantage in comparison with other countries. Surplus production forced farmers to realize more clearly the need of co-operative combinations to meet the local buyers on better terms, and to establish direct connection with overseas markets. Few to-day deny the soundness of co-operative principles, and when the machinery and safeguards provided by the Act were understood, organization progressed apace.

The spirit of co-operation must be gladly welcomed. If judicious use is made of it the possibilities will be immense. However, the realization of the need to combine must spring from within, and must not be forced from without. Farmers must feel the need of co-operation to improve their conditions. Prematurely formed organizations have proved a danger to the whole movement, as they too often fall in their first encounter with adversity. Failures discredit the movement, and therefore proper use must be made of the prevailing enthusiasm, so that the structure we are building is placed on a sound foundation. The Division constantly endeavours to ensure that no association is registered unless the ordinary essentials for success, such as sufficient turnover, proper management, etc., are present. Attempts were observed to form co-operative associations, the objects of which could not possibly be carried out successfully. There is, however, great scope for sound co-operative effort. The following figures give some of the results already attained:

Associations which existed at Date of Commencement of New Co-operative Act (August 14, 1922) and now Registered Thereunder:	
Unlimited Societies formerly registered under the old Co-operative Laws	64
Limited Associations formerly registered under the Companies' Laws of the four Provinces	36
Unlimited Associations formerly registered under the Companies Laws' of the four Provinces	2
	102
New Co-operative Agricultural Companies and Societies formed under the New Co-operative Act, to June 30, 1923:	
Limited Associations	42
Unlimited Associations	5
	47
Total Co operative Agricultural Associations registered under the new Co-operative Act	149

. . . The membership of the unlimited associations is 13,525, and of those with limited liability, 16,799, a total of 30,324.

The report also gives a review of the position and progress of co-operative societies which have been formed to deal with the following products: maize, tobacco, cotton, fruit, wine, meat, ground-nuts, wool, eggs and poultry, timber and wattle bark, dairy cattle, cheese, and sugar.

It is stated that cotton readily lends itself to co-operative treatment, and considerable success attended efforts to organize cotton growers during the past year. Co-operative companies now exist in Swaziland, Barberton, and Rustenburg Districts. Four co-operative cotton associations, with a membership of 944, are now established in the Union; three of these, with the Swaziland Co-operative Growers, Ltd., have affiliated to the Central Co operative Cotton Exchange, which effects the sale of their produce. The Exchange has recently put forward a demand for a levy on cotton exported to provide funds for the development of the industry, and it is said that the claim is backed by a majority of growers.

The Barberton Co-operative Cotton Company has recently erected an excellent ginning plant, which is well supported, and should prove very successful. The new organization in the Rustenburg area has doubled its membership since its inception, and has every prospect of a successful future. The South African Cotton Growers, Ltd., which operates in Natal and Zululand, has done much to promote cotton growing in these provinces.

275. A Successful Co-operative Cotton Ginnery at Barberton. By Lloyd Worrall. (*J. Dept. Agr., S. Africa*, vol. ix., 1924, pp. 397-408.) A very instructive article which should be read by all who are interested in installing ginneries.

276. We quote the following from the Annual Report of the Department of Agriculture, South Africa, June 30, 1924, recently received:

"The rapid advance of the cotton-growing industry has caused a good deal of attention to be paid to organizing producers on a co-operative basis. Growers are vitally concerned in keeping ginning and selling costs down, and they have not been slow to recognize the value of co-operative methods in this connection. Six local co-operative associations are now established in cotton districts, so that a healthy framework exists which should grow in strength as larger areas are put under cultivation."

277. CO-OPERATION: SUGGESTED EFFICIENCY FACTORS FOR CO-OPERATIVE SOCIETIES. By G. G. Auchinleck and S. B. Yatawara. (*Trop. Agriculturist*, Ceylon, vol. lxiii., 1924, p. 298.)

278. AGRICULTURAL CO-OPERATION IN INDIA. By H. Calvert, I.C.S., Registrar of Co-operative Societies, Punjab. (*Int. Rev. Agr. Econ.* (*N.S.*), II. 1; repr. in *Agr. J. Ind.*, xix., 1924, p. 515.)

279. THE CO-OPERATIVE MOVEMENT: STRENGTH OF AGRICULTURAL SOCIETIES. By H. J. Twigg (*Manch. Guard. Coml.*, Empire No. 7, October 16, 1924, p. 32.)

280. CO-OPERATIVE COTTON MARKETING: SAFEGUARDING A FAIR PRICE TO THE GROWER. By C. B. Howard. (*Manch. Guard. Coml.*, Ann. Rev. of Amer. Cott., August, 1924, p. 45.) The author explains the working of the co-operative cotton marketing organizations of America, which have for their main objects the stabilization of prices by the gradual marketing of the crops, the elimination of middlemen's profits, the prevention of damage to the cotton by immediate storage after ginning, and the decrease of storage and insurance charges by the concentration of cotton in large quantities in modern concrete warehouses.

MISCELLANEOUS.

281. RESEARCH IN RELATION TO THE COTTON INDUSTRY. By Dr. A. W. Crossley, C.M.G., F.R.S. (*J. of Text. Inst.*, vol. xv., No. 6, 1924, p. 209.)

282. COTTON AS A FOOD CROP. HOW IT IS "EATEN" IN U.S.A. From the *West India Committee Circular* we extract the following:

> An acre of cotton producing 750 pounds of seed cotton furnishes 500 pounds of seed, from which about 10·5 gallons of oil can be expressed. This oil is easily converted into oleo, butter, edible cooking oils, and lard compounds, which are in general use. Cotton seed furnishes in great abundance another equally important element of food for man and beast—viz., protein, the most necessary and expensive element of all foods and feeds. In 500 pounds of seed there is approximately 225 pounds of cotton-seed meal, analyzing 36 per cent. protein. On the basis of protein alone this is found to be equal to 787 pounds of corn or 675 pounds of wheat.

283. WORK OF THE SHIRLEY INSTITUTE. By Dr. A. W. Crossley, C.M.G., F.R.S. Director of Research. (*Text. Rec.*, vol. xlii., No. 498, 1924, p. 53.) An interesting report on the research work being carried out at the Shirley Institute.

284. COTTON AND THE COTTON MARKET. By W. H. Hubbard. (D. Appleton and Co., London and New York.)

PERSONAL NOTES

We regret to announce the death at Blackburn of Mr. Joseph Cross, a prominent figure in the cotton industry for many years as a weavers' trade union official. Mr. Cross was one of the representatives of the Association of Operatives on the Council of the Corporation, and was also a member of the Executive Committee.

APPOINTMENTS.

Mr. M. A. Bailey, M.A., late of the Ministry of Agriculture, Egypt, has been appointed by the Corporation as Plant Breeder attached to the Sudan Government, the appointment to take effect as from April 1.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street) immediately opposite to the offices of the Crown Agents for the Colonies.

At the date of writing the following officers are on leave in England:

Gold Coast	Mr. A. B. Culham.
,, ,,	Mr. H. A. Dade.
,, ,,	Mr. H. K. Hewison.
,, ,,	Mr. H. Nicholas.
Nigeria	Mr. R. F. Martin.

Mr. G. R. Hilson, Cotton Specialist, Madras, is on leave in England.

Mr. R. C. Wood, a member of the Corporation's staff abroad, is also on leave in this country.

Coming on Leave in May.

Mr. S. Milligan, the Corporation's cotton expert in South Africa.

Dr. W. Burns, Principal of the Agricultural College, Poona, Bombay.

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THE
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REVIEW

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QUEENSLAND COTTON GROWING

BY
G. EVANS, C.I.E., M.A.
Director of Cotton Culture, Queensland.

THE serious shortage in the raw cotton supplies of the world that has eventuated since the close of the war has directed a great deal of attention to the possibilities of extending cotton cultivation within the territories included in the British Empire. Naturally much thought has been applied to this problem in Australia, and determined efforts to establish this crop on a permanent basis have been made, especially in Queensland. It is thought, therefore, that an account of the present position of the cotton-growing industry in this State of the Commonwealth may prove of interest. This is more particularly the case, perhaps, since Australia presents the unique instance of a country which is endeavouring to establish a cotton-growing industry on a large scale by the utilization of white labour alone, and without assistance from coloured races in any shape or form. The problem is, therefore, a most interesting one, and is really an attempt to demonstrate that the white man can, by the application of superior skill, intelligence, and mechanical methods, compete successfully in the production of raw cotton on a commercial scale in spite of a higher standard of living that demands, as a natural sequence, bigger wages.

Cotton growing is not a new industry in Queensland. Various attempts to establish the crop have been made in the past seventy or eighty years. It was first tried about the year 1866, when 14 acres were under crop. Cultivation received a great impetus at the time of the American Civil War, which resulted in a cotton famine, prices ruling exceptionally high as a result. For a period of about five years the area under cotton was about 12,000 acres annually, culminating in the year 1870, when 14,674 acres were under the crop.

In 1871, 6,505, bales were exported. Up to the time of the re-entry of American raw cotton upon the European markets and the consequent decadence, through competition, of the industry that had been established in Queensland, cultivation was mainly carried out on the plantation system, for which Kanakas from the South Sea Islands were imported.

The Government of the day fostered the industry during this period by a bonus on exported cotton varying from £10 to £2 10s. for each bale of 400 lbs. weight of ginned cotton exported. The highest price obtained was 2s. 2½d. per lb. in Liverpool in 1864, and the total bonus paid that year amounted to £84,868. Owing to the cessation of the bonus and the resumption of the export trade by America after the termination of the Civil War, cultivation in Queensland declined until in 1887 there was no area under crop. Cotton growing was again taken up between 1890 and 1897, when the Ipswich Cotton Company was established, being encouraged by a Government bonus on the first 5,000 yards of cotton goods manufactured. The Company secured the bonus, but afterwards went into liquidation. The cotton at that period was grown mainly in the area between Ipswich and Toowoomba, and it is interesting to note that this district is producing some of the best cotton at the present time, and seems to be particularly suited to the crop.

The drought of 1902 ushered in a third period, during which cotton was advocated by the Department of Agriculture as a subsidiary crop on the farm, with a view to introducing not only a money-making crop but also a drought resister that could be used for fodder in case of absolute necessity. It is also interesting to note that in 1904 the Department imported 2 tons 16 cwt. of the following varieties of cotton seed:

Sea Island varieties	Rivers and Seabrook.
Egyptian varieties	Mit afifi and Ashmouni.
Upland American varieties	Russell's Big Boll, Peterken, Truitts, Culpeper, Jones' Improved, and Southern Hope.

At this time there was no experience or exact knowledge available of the requirements of the markets, and the seed was distributed to growers, with the result that in a short time it became hopelessly mixed, and Queensland started on her fourth attempt to grow cotton with the handicap of a badly mixed seed that contained elements of various Sea Island, Egyptian, and Upland types, all of which had become intricately hybridized with each other. The Department at the present time is endeavouring to displace this seed as fast as possible by pure types established on a community basis.

The cotton famine which has resulted in the high trend of prices since the termination of the war did not escape the notice of the Australian authorities, and the Queensland Government in particular determined to make a big effort to establish the crop on a permanent basis. Contact was established in the first place with the British Cotton Growing Association. In 1920 this Association, in order to stimulate production, agreed to guarantee a price of 1s. 6d. per lb. for clean and good quality cotton forwarded to them freight and insurance paid for sale at Liverpool, for a period of five years, the loss throughout the period not to exceed £10,000. This sum soon came to an end, but a system of guarantee firstly by the State, and then by the State and the Federal Governments conjointly, was brought in, and a promise was made to the growers to pay 5½d. per lb. for all seed cotton free from disease and of good quality, grown prior to July 31, 1923. The cotton was to be delivered at the nearest railway station or port by the farmer; the transport charges were paid by the Government at first, but they have later on been charged against any profits accruing in addition to the advance. The growers were at first supplied with seed free of cost, but are now charged the small rate of ½d. per lb. The Government also entered into an agreement with the newly formed British Australian Cotton Association to act as agents for the Government for ginning, baling, shipping, and selling the cotton so acquired by them under the guarantee. This agreement is in force until the end of the 1926 ginning season. The system of guaranteed prices to the growers has also been extended to that date, although the basis is slightly different, averaging 5d. a lb. for the past season 1923–24, and for the coming season, 1924–25. A system of grading the seed cotton has now been introduced with a view to facilitating marketing, and for the encouragement of clean picking, and the consequent production of better cotton. The higher grades obtain slightly more than 5d., whilst lower grades get a correspondingly smaller price. It will be realized, therefore, that up to the present the policy of the Government has all along been to encourage the production of the highest quality cotton, as it was realized that if cotton is to be established on a permanent basis in the Commonwealth only the best quality can be profitably grown. The cost of living is high, and as the long distance from the markets means that the freight charges are unusually heavy, it is doubtful whether the production of inferior short staple cotton, in which, under normal conditions, the world's markets are not lacking, would prove economically feasible. It is partly for this reason and also on account of the necessity for controlling insect pests, that Government is offering an advance of 3d. only for ratoon cotton, since experience has indicated that it is distinctly inferior to the annual growth when produced under similar conditions.

Under this system of guarantees the cotton crop has made remarkable progress in the last few years, as the statement below will indicate.

Number of Growers.	*Year.*	*Acreage Brought to Bearing.*	*Seed Cotton Received in Pounds.*	*Guaranteed Price.*	*Total Paid to Growers.*		
				d.	£	s.	d.
117	1919-20	166	45,581	5½	1,038	7	10
716	1920-21	1,967	922,778	5½	21,145	0	2
1,657	1921-22	8,176	3,878,673	5½	88,460	0	0
8,283	1922-23	28,695	11,769,502*	5½	264,399	12	0
7,500 (approximately)	1923-24	35,373	15,201,784	5	315,208	2	1

These figures indicate the rapid increase that has been made in a few years under the stimulus of a guarantee, and it is probable that progress would have been materially greater if the last two seasons had not been exceptionally unfavourable.

The 1921-22 season was a good one, and the rains came at very opportune times, so that conditions appear to have been very favourable to cotton growing. Big yields per acre were obtained, and in many cases careless and hurried cultivation met with a reward that was not altogether deserved, and led many people to believe that the crop did not require careful methods of cultivation. The excellent result obtained during this season was followed by a veritable cotton boom. Everybody talked cotton, the Press was full of it, land agents disposed of large areas as cotton farms, and a great many persons planted cotton who had no real knowledge of agricultural methods. The new class of cotton farmer was sometimes a grazier who hoped to tide over the bad times on which the cattle industry had fallen after the war by making easy money in cotton. In other cases, men went on to the land who had no previous agricultural experience, but had been brought up to other trades. Both these classes of settler were, as a rule, ill-equipped with the proper implements, and often lacked sufficient capital. A certain number also came from the Southern States, and, as a rule, they were good practical farmers.

* Threepence a pound only advanced on ratoon.

They were usually somewhat handicapped, however, by want of experience in the cultivation of tropical crops, and were misled by the wild utterances of irresponsible writers, which were published wholesale in the local press when the boom was at its height. The planting season at the end of 1922 was, on the whole, favourable, and a large area was sown, but the regular rains in January, February, and March entirely failed, the result being that whole areas of the cotton that had been planted on newly broken and indifferently prepared land failed entirely. The regular farmer, however, who had chosen the right type of land, fallowed it through the winter and kept his cultivators going in order to conserve soil moisture, did not do at all badly, and some really good yields were obtained. The crop as a whole, however, was a disappointment, but it at any rate served to emphasize the fact that cotton is much like other crops in that it needs careful cultivation, and has its own peculiarities regarding soil. The " boom " cry that all one had to do was to half-plough the land, stick in the seed and go away for a long holiday at Christmas, was proved to be thoroughly impracticable.

The succeeding season rubbed in this lesson further. The year 1923 was a very dry one throughout—in fact, the drought is said to have been the worst for twenty years or more. The winter rainfall was lighter than usual, and the spring thunderstorms were precarious. Those farmers who had not ploughed during the winter or previously prepared their land had difficulty in getting a strike, and plantings were not general until the December rains set in. The men who had taken these precautions, however, were in some cases able to plant in September and October and achieved very fair results.

The complete failure of the maize crop in 1922–23 owing to the drought encouraged many growers to give cotton another trial, as in spite of the poor results obtained from cotton, those from maize had been even worse. The seed applied for in the last few months of 1923 was about the same as in the previous year, but owing to the circumstances described above, the greater part of the crop was not planted until December, which is later than is usually considered to be desirable. A very hot, dry spell occurred in January, which caused a good deal of boll-shedding in the main crop and premature ripening in the early planted areas. In February and March, 1924, very heavy and continuous rain was experienced, and under these conditions the late plants went to vegetative growth, putting on a great deal of wood. Matters were complicated by the appearance of the maize worm (*Chloridea obsoleta*) in vast numbers. This pest, it is said, usually appears in an epidemic form at the break-up of a long drought, and if this is a fact, 1924 certainly proved no exception to the rule. Throughout the month of February enormous damage was done, but towards the end of that month parasites began to appear and speedily put a check to further depredations. The whole of the bottom crop of bolls in the main (late) crop, had by that time been ruined, especially on the heavy soils. It was noticed, however, that the early plants and the crops planted on the lighter and better drained souls suffered less damage. The cotton grower was not free from his troubles even now, as in some of the inland areas a sharp frost was experienced about Easter time, which is much earlier than usual, and this did some damage to the top crop of young bolls. In spite of these disasters, however, it was again noticed that certain farmers, by employing proper methods of cultivation and planting on the right types of soil, had secured yields that were quite remarkable, considering the adverse nature of the season.

The experience of the past three seasons has taught the grower a great deal about the conditions that are essential for the successful cultivation of cotton in this State. Much clearer ideas have now crystallized with regard to the right types of soils, the best methods of cultivation, the proper implements, the time of planting, spacing, and other details, and no farmer is now so ill-prepared to deal with this crop as he was three years ago. Above all, the pressing necessity for careful experimental work on this crop was made clear.

The potential cotton area in Queensland is of very large extent. The main belt may be said to extend from the New South Wales border to about Mackay, where it touches the southern border of the tropical sugar area, a distance of some 500 miles, and to reach roughly for 200 miles inland. All this area is, of course, not cotton land. There are areas, round Bundaberg and the Tweed, which have too heavy a rainfall, and are devoted to sugar cane. In some of the areas west of the main range also the rainfall is somewhat too light or too uncertain to render cotton anything but a precarious crop. Other potential cotton belts occur in the North, but scarcity of population and the incidence of other forms of agriculture has rendered it impracticable to pay much detailed attention to the cotton possibilities of these areas, with the limited Departmental staff available.

The main belt is mostly coastal country and consists of a series of ridges and valleys running roughly eastward to the sea from the main range. The latter varies greatly in height and configuration, but lies from 50 to 100 miles distance from the sea. Generally speaking, the country east of the main range is much more broken than it is to the west, and has a heavier and more dependable rainfall. The country in the south-west consists of a series of elevated tablelands ranging from between 2,000 to 3,000 feet on the Darling Downs between Toowoomba and the New South Wales border, and extending westward in flat plains of lower elevation towards Roma. This latter district is known as the Maranoa and comprises a large area of brown and red loam soils that are very suitable for cotton. The rainfall is somewhat uncertain, however, and the winters are often cold enough to kill out most of the cotton. The population is scanty and for the most part employed in pastoral pursuits. There is little doubt, however, that if winter fallowing is practised, and the best use is thereby made of winter and spring rains, good cotton can be grown. Production, except in one or two centres, is limited for the time being by the sparse population, whilst large areas of the best soils are at present infested with prickly pear. The soils on the Darling Downs are mostly of a heavy black clayey nature, and this class of soil has not given the best results with cotton in Queensland. In a dry spring it cracks badly, and is liable to prove droughty, while, on the other hand, during rainy spells, it is impossible to get on to the land, and consequently the weeds beat the cotton. The country between Toowoomba and Brisbane possesses great possibilities, and some of the finest cotton is now being sent in from this area. The numerous creeks and valleys that descend into the Lockyer, in particular, are becoming famous. The low-lying flats are usually reserved for lucerne and maize, but the slopes, which consist of grey and brown loams often with a substratum of clay over gravel, produce cotton of exceptional quality if properly cultivated. This is one of the oldest and most closely settled districts of Queensland, and the farmers are consequently better acquainted with local conditions and more fully equipped than in some of the more recently settled tracts. Also, there is a certain amount of cotton tradition in this locality, since most of the cotton produced in the old days and during the nineties came from the area behind Ipswich. Further north we find excellent cotton country in the watershed of the Burnett, a river that drains a vast area. The Kingaroy district, with its high plateaux of bright red scrub soils, appears to be better suited for maize than cotton, but the brown forest lands, the grey scrub soils, and the sandy alluvials along the creeks of this area are proving very suitable. Here again the farmers are learning to avoid the heavy black soils. In this tract, as in the Rockhampton and Dawson Valley areas further north, which are also very suitable for cotton growing, the soils are extraordinarily mixed. Patches of good forest or scrub land are separated by extensive ridges of poor and shallow soils usually covered with ironbark trees or cabbage gums. In fact, the lack of homogeneity of the soils throughout the main cotton belt is a feature that must immediately strike any stranger who happens to be acquainted with other cotton-growing countries. There is nothing in common here with the large irrigated deltas of the Punjab, Egypt, and Mesopotamia, or the vast extent of the black cotton soil plains of Berar and the Deccan in India. In the well-known Dawson Valley area considerable areas of alluvial flats do occur along the Dee, the Don, the Callide, and the other creeks and rivers that go to make up this district, but even these vary a good deal in the nature and character of their soils, and are intruded upon by patches of brigalow clays, bottlewood scrub, and low-lying marshy country. This complexity of soils naturally renders the task of instruction in cotton growing no easy one. Certain broad principles can be followed, but exact cultural details will need to be worked out for each particular class of soil. The Department of Agriculture is accordingly encouraging farmers on different types of soils and in different localities to carry out certain simple experiments for themselves, with a view to elucidating such details as the correct distance for spacing, the best time for planting, and similar matters that are purely of local application.

It is obvious that under the circumstances described above cottons of different character are likely to be produced from one and the same district. As a matter of fact, even when the same variety is planted throughout, distinct differences are observable, although these differences are naturally less than when mixed seed or different varieties are grown. "Hill" cotton is of a different character from that grown on the alluvial flats, although both may be produced by the same farmer on the same selection. The importance of grading is at once apparent, and the energetic and prompt measures that have been taken by the Government to establish a system of grades and to train men in the finer points of the work are already beginning to have beneficial results. Many of the growers already appreciate the need for grading, and it is hoped that in a short time the community as a whole will realize the necessity. The great benefit that will result if they can contrive to keep the growths from different classes of soils and the different pickings separate for consignment to the ginnery will certainly be realized in due course. At present, as is perhaps natural, this aspect of the industry is still not fully appreciated.

Probably the most urgent work at the present time is the rapid improvement of the seed supply. When the sudden revival in cotton growing took place in 1920 the only seed available was very mixed. It was, in fact, the direct descendant of those varieties before mentioned which were imported in 1904, possibly mixed with one or two further additions at a subsequent date. Having been grown as a mixture for many years it can be readily imagined that this seed has not proved satisfactory. The staple is irregular, as is only natural, having regard to the different elements from which it is descended, but apart from this the plants vary greatly among themselves both in the manner of growth, the time of ripening, size of bolls, and other vital matters. Also numerous degenerate hybrids now occur which occupy a great deal of space in the field, but yield little cotton. The problem of replacing this mixture by a uniform variety of desirable type is being solved as rapidly as possible. It was not found practicable to import large quantities of fresh seed from abroad on account of the danger of introducing alien pests and diseases. A small quantity of Durango seed was, however, introduced in 1917, and has given satisfactory results. A further small consignment of this variety was imported from America in 1921. It has been tested out under varying conditions by selected farmers under departmental supervision, and in the present year some 6,000 acres are under crop, which should suffice for the whole of next season's seed supply. The cotton seed supply and its distribution is controlled by the State Agricultural Department, and the system employed has been to confine the pure seed to groups of farmers in certain selected localities. These groups consent to certain conditions, the chief of which are that they will plant the seed on clean land and will all agree to grow only the one variety. It is hoped by an extension of this community system to introduce new and improved types from time to time in the future, and to maintain the purity of the seed.

The first step towards improving the seed by replacing the old mixed seed with a pure variety of proved merit is thus within measurable distance of completion, although the final elimination of the old mixed seed is bound to be delayed owing to the practice of ratooning that has now been permitted by recent legislation. But that is only the beginning of the work, and much detailed plant-breeding will need to be done before really satisfactory types, suited to all the different sections of the cotton belt, can materialize.

A Central Research Station has just been established at Callide in typical country behind the main range midway between Rockhampton and Gladstone. A subsidiary station is located at Monal in the Upper Burnett country, and experimental work is also being carried out for the south-eastern area at Gatton Agricultural

College. A separate station is really needed in this latter district, as the conditions at the College are not truly typical, but the temporary arrangements that have been made, through the courtesy of the College authorities, meet the needs of the situation for the time being. Experiments are being conducted in cultural problems connected with the preparation of the seed-bed, spacing and thinning operations, manurial trials, testing different methods of pruning and ratooning cotton after the first year's growth is completed, and other relevant matters. The chief object of these stations, however, is plant breeding, since the securing of types of cotton to suit local conditions is considered of paramount importance at the present stage of development. Much attention is being directed to the Durango variety, which after three or four years in this country is showing signs of "new place effect." Slight variations are observable in the character of the lint, the habit of growth, earliness, and other important factors, and it seems to indicate that the variety is making an attempt to adapt itself exactly to local conditions. Straight selections have been made, and it should be possible in the course of a few years to evolve new types of Durango that will give even better results than the present seed. It is also realized that one variety may possibly not meet the needs of such a widely extended cotton belt as Queensland possesses, and similar breeding work is being carried out by the Department on Acala, Lonestar, and Webber 49. Other varieties that are being tested by the Department on a small scale are Lightning Express, Delta-type Webber, and Delfos.

The avowed policy of the Government has been to produce a high quality cotton of the long staple class that would be likely to secure good premiums. It was realized from the first that cotton prices cannot be relied on to stay at the abnormally high levels of 1922–24, and that when the drop came the best chance that Queensland would have, for establishing her new industry permanently, would be by producing a high-yielding cotton with a long staple realizing a premium sufficiently great to counteract the handicap, in comparison with other cotton growing countries, of a high cost of living and larger freights owing to the distance from the markets. The Department is accordingly aiming at producing cotton that will give a staple of $1\frac{1}{8}$ inches full to $1\frac{1}{4}$ inches, and if possible averaging $1\frac{3}{16}$ inches, and it is hoped eventually to secure an average premium of 300 points or so for the greater part of the crop in normal times. Under the conditions existing in this country, this deduction would seem to be logical, but it must be realized that this desirable state of affairs cannot eventuate unless the growers as a whole raise their standard of cultivation. Profitable yields per acre of good quality cotton cannot be relied on year in and year out unless the most intelligent and up-to-date methods are employed, and Queensland is no different from other countries in this respect. There are large areas of this State which have already proved their capacity to produce this class of cotton, and it remains with the grower to prove that cotton can be made a commercial proposition on this basis. He has one big factor in his favour—namely, that suitable land is cheap compared with the older established cotton countries in other parts of the world.

If inferior methods of cultivation are employed, both the yields per acre and the quality will suffer. If short-staple varieties are grown, then the Australian farmer will at once be brought into competition on the world's market with the coloured grower in other places, who is producing a large quantity of this class of cotton and can put it on the market more cheaply, owing to his lower cost of living.

It is partly for this reason that the practice of ratooning cotton may, to my mind, eventually prove unsound, because although the quality of second-year cotton varies with the degree of cultivation employed, the season, soil, and other factors, there is every evidence to show that it is decidedly inferior as a whole to the annual, being not only shorter in the staple, but singularly deficient in "drag," due presumably to lack of twist in the fibre. If the two classes are mixed together, the practice can only result in a loss of reputation for Australian cotton, and consequent damage to the industry as a whole. It is possible that under certain conditions, in certain localities, and during certain seasons, a properly ratooned crop may do well. In an exceptionally dry season, such as that of 1923–24, the ratoon may even in some cases yield better than the annual. The occurrence of this drought really led up to the agitation that resulted in the modification in 1924 of the Act of Parliament prohibiting ratoon. In the present season, when more normal weather conditions are occurring, many farmers are now finding out by actual experience that ratooning is not the panacea they were led, in some quarters, to expect. In the districts away from the coast, the ratooned cotton has mostly died out during the winter, and the stand is so poor that in many cases the farmer, after waiting for some months for the plants to sprout, has had to plough out and plant fresh seed. On the higher land, on the lighter soils, particularly upon the central coast, however, a better strike has sometimes occurred. Again, the ratooned plant puts out a large number of suckers from the crown early in the spring. These are more than the root can properly support, with the result that as soon as the summer sets in, the plants wilt badly in the first hot spell during December and shed most of their young bolls and squares. This seems to be particularly the case on the fertile alluvial soils and dark loams, possibly because the plants in their first year of growth do not develop a sufficiently deep or extensive root system in this class of soil to support the large number of suckers that are thrown out by them in the succeeding spring. Under other conditions, where the ratooned plant has managed to partially withstand the drought and has not shed its squares, there is a tendency to produce large numbers of small bolls and cotton which, since it is produced during the driest time of the year, is deficient in staple. It is probably for this reason also that ratoon cotton is usually much harsher to the touch than annual, is markedly deficient in "drag," and under some circumstances is lacking in strength. A further disadvantage is the habit of the ratoon bush of keeping low and spreading over the ground, the result being that many of the bolls are down on the ground, and those that do not rot off in wet weather produce a low-grade cotton. For this reason also ratoon cotton is proving more difficult, and therefore more expensive, to pick. This peculiar habit also prevents the farmer from getting on to the crop with his cultivating machinery, with the result that, except on small areas where he can go in with the hoe, he finds it impossible to keep the fields clean. This season, with its wet spring, has shown us the spectacle of large areas of ratoon cotton smothered by weeds and to all appearances abandoned by the farmer.

The chief danger from ratooning, however, lies in the occurrence of insect pests. The term "ratooning" is being interpreted in a liberal manner by the farming community. The majority attempt to carry out the law and cut down their plants to within 6 or 8 inches of the ground. In other cases the cows are turned in, and in further instances the crop is simply left to stand over, or the standing crop is sown with Rhodes grass and left as a grazing paddock. It can be readily imagined that cotton growing under these conditions is a veritable paradise for such pests as the Pink Boll Worm, the Tectacoris bug, the Earias, and the supposed Peach Moth (p. 238). The stand-over cotton in the coastal belt, where there is no frost, produces green bolls right through the winter and spring, and affords a safe refuge for these pests. As the cotton pruned to the ground is about two months earlier than the annual, it will readily be realized that the Pink Boll Worm and other pests are thus enabled to carry over from one season to the other, and are therefore already present in considerable numbers when the main crop comes into bearing.

The menace of the Pink Boll Worm is only just beginning to be understood by the grower, as its methods of attack are insidious, and it is consequently easily overlooked in the early stages by one unacquainted with its habits. Every precaution is being taken by Government to prevent the spread of this pest to clean areas, and Simon's Heaters have been erected at the ginneries to ensure that the seed is thoroughly treated before issue. The control of the pest in those localities where it is already established is, however, in the hands of the farmers themselves. Its effectual control eventually will prove to be a community matter, and it seems possible to visualize a time in the not far distant future when any farmer who persists in standing-over his cotton beyond a specified date will come to be regarded as a danger, since it will be realized that a neglected crop will prove a sure source of infection to neighbouring plots. A few seasons' experience with this pest will, it is anticipated, speedily bring home the necessity for a close season, during which no cotton bushes shall be above ground, as by this means the pests can be starved out and their increase checked. The growers will undoubtedly also learn by experience, as they have done in other countries, that it will be wise to sacrifice the last of the top picking and to cut out and burn their bushes in the winter with a view to ensuring that the following crop does not suffer unduly from pests. As the matter stands at present, Queensland is unique among the cotton-growing countries of the world, in that after the appearance of the Pink Boll Worm the regulations against pests were relaxed, whereas in every other place in which this dreaded insect has appeared it has been found necessary to bring in the most stringent legislation without delay. It would seem probable that this matter will be forced into prominence in this State also, and that drastic action against this pest will in due course be necessary.

It is thus evident that both from the point of view of the production of high-class cotton and the control of insect pests, clean and careful cultivation methods must be employed. The reason why so many dirty cotton fields are seen in certain districts is because the farmer is trying to cultivate an area that is too large for the resources he has available. In the newly opened areas of the central district, many of the new settlers appear to be making the mistake of relying solely on cotton, and have therefore put in larger areas than they can possibly handle properly. In a new burn on scrub land it is no uncommon sight to see one farmer with 60 or 70 acres planted in the ashes. In the first season he is all right, since very few weeds spring up in a newly burnt piece of land. In the second season he is confronted with the problem of either removing or ratooning this large area of cotton plants. He cannot plough out because of the stumps, and he is often unable to obtain or else cannot afford to pay for hired labour. The result is that, although he may endeavour to ratoon the crop, he cannot help being late in completing the task on account of the large area. Sometimes part of the crop is not touched at all, and remains a standing menace to the whole district. In either case, he is lucky if he gets a paying crop, and he would probably make more profit if he confined his efforts to an area one-quarter the size.

In the older settled districts of the south-east and in the Burnett, cotton is being grown as an additional crop, in conjunction with dairying, and maize, potato or peanut growing, or the cultivation of lucerne or other fodder crops. Under these conditions, the farmer limits his cotton patch to anywhere from 5 to 20 acres in accordance with the size of his family or the local help available, and the crop is usually well cultivated and looked after. The result is that big yields per acre are usually obtained and the crop is cheap to pick, for paradoxical as it may seem, the better your cotton crop, the cheaper it is to pick. On small well-cultivated areas such as these, definite instances of yields of as much as a ton of seed cotton per acre have been recorded, and many returns of £50 or more are not out of the way. The quality of the cotton produced under these conditions is also very good as a rule. This is a factor that will count greatly when Government control ceases. Then presumably the farmer will sell his cotton direct to the buyer, and will thus get the correct price for his cotton based actually on the quality of his particular consignment.

It seems obvious, therefore, that the plantation system of cotton growing has not much chance in Queensland at the present time, and, as a matter of fact, the tendency year by year is for the individual areas to decrease. The principle of endeavouring to obtain high yields per acre from smaller areas by intensive methods of cultivation needs to be encouraged. If this system is adopted and intelligent attempts are made to observe a close season with a view to controlling insect pests, there is no reason why Queensland should not establish a permanent cotton industry. The farmer and his family will do practically all the work themselves and so keep all the profits in the home. Even if the price of raw cotton were to stabilize at about a shilling, it should still pay handsomely to grow cotton under this system, since it has been abundantly proved that cotton is well suited to certain large tracts of the State. One of the great attractions is the fact that, unlike maize or potatoes, cotton is not dependent on the local market, and prices do not therefore slump owing to a local glut due to over-production in a good season. Also, since cotton can withstand short periods of drought better than maize, which is its chief competitive crop in these areas, there is an increasing tendency for cotton to be brought into the cropping system as a regular practice. It should therefore prove of great benefit in the immediate future in helping to establish closer settlement, since it provides a suitable cash crop. This has up to the present been absent in the farming system of certain large areas of the State, and has probably been the cause of retarding land settlement in this belt. A new settler can get a cash return from cotton in about eight months.

The cotton-growing industry has progressed rapidly during the last three years, and is likely to expand more slowly, but nevertheless it is hoped steadily and on sounder foundations, in the next few years. The production of this crop under existing economic conditions will probably be carried out by the small farmer, and big plantations are, perhaps, not so likely to prove a commercial success.

Considering its vast extent, the population of Queensland is at present very small. Of the eight hundred thousand people in the State, about half reside in the towns, and when it is considered that there are enormous pastoral areas to be staffed, that Queensland has a large and important sugar industry, that fruit growing, wheat production, and mining each claim their quota, it is really remarkable that the small population available for mixed farming in the cotton belt has been able to achieve the results it has done towards production in recent years. It is perfectly obvious, nevertheless, that any great expansion of the industry must depend entirely on closer settlement and on the rapid increase of the population on the land by the immigration of a suitable class of settler. Although a single farmer could probably manage to cultivate properly a field of perhaps 30 acres if he had the necessary implements of proper design, he could not pick a quarter of this area. Unless, therefore, really practicable mechanical cotton-pickers are invented (and this is likely to prove a matter of close co-operation between the plant breeder and the mechanical engineer), it would appear to be probable that any future increase in area will depend on the increase in the number of individual farmers in the cotton belt.

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THE PAST, PRESENT, AND FUTURE OF COTTON GROWING IN NIGERIA

BY

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THE earliest travellers to the valley of the Niger report that cotton was grown both by the Yorubas of the coastal belt and also by the Hausa-speaking tribes of the hinterland to supply the local hand-weaving industry, and so meet the demand for cotton goods. We read that in 1857 at the village of Ila near Ilorin, on large market days, from 1,000 to 2,000 headloads of cotton would be offered for sale—a quantity far in excess of anything which could be seen there to-day. In those early times the types of cotton grown in the different parts of the country, now known as Nigeria, varied considerably. They included the following species:

Gossypium peruvianum,
Gossypium vitifolium,
Gossypium obtusifolium,
Gossypium punctatum,
Gossypium arboreum.

Of these, the first two were predominant—indeed, they were the only species of economic importance as far north as the eleventh degree.

In the Emirates of Sokoto, Kano, and Bornu, however, they were largely replaced by *Gossypium obtusifolium* and *Gossypium punctatum,* the former a perennial cotton of great drought-resisting capacity, the latter an annual coming to maturity very rapidly. Both these varieties are of little value from the point of view of export, being of very short staple, and of a very low ginning percentage.

The earliest recorded export of cotton from Nigeria was in 1856, when hand-gins were first installed at Abeokuta, and 100,000 lbs. of lint (the equivalent of 250 modern bales) were shipped and sold in Manchester at 6d. per lb., the consignment fetching £2,500. By 1869 the output had risen to a value of £76,957, having been no doubt greatly stimulated by the high prices prevailing owing to the cotton famine in Lancashire, due to the American Civil War.

This young export trade, however, steadily dwindled to a value of £526 in 1879. It was worth only £150 when the British Cotton Growing Association first started operations in Nigeria at the beginning of the present century. They began by establishing power ginneries, in the first instance at Abeokuta on the Western railway and at Lokoja on the Niger, and offered a cash price for all seed-cotton. The cotton purchased was of two different types, the so-called "Meko" cotton (*Gossypium peruvianum*) grown in the Abeokuta area being of a distinctly inferior type to the "Ishan" (*Gossypium vitifolium*) of the Niger and Benue valleys, which found its way to the Lokoja ginnery. As the railway from Lagos to Kano penetrated further north, it became possible to begin the development of the cotton exporting potentialities of the Northern Provinces with their population of 10 millions—a figure in excess of that of the combined populations of Uganda, Tanganyika, and Nyasaland. To this end the Association opened a large ginnery at Zaria, and started purchasing the indigenous cotton (*Gossypium peruvianum*). This, again, was of a somewhat different type to the cottons of the Southern Provinces, being of better grade, owing to the drier climatic conditions, but sharing with the southern cottons their roughness and having a ginning percentage of about 30. The lint was about an inch long. The value of this cotton on the Lancashire market was generally about equal to that of American middling.

COTTON EXPORTS FROM NIGERIA (IN BALES OF 400 POUNDS).

	Southern Provinces.		*Northern Provinces.*			
					Price per Pound Locally.	
	Total.	*Including American.*	*Total.*	*Including American.*	*Native.*	*American.*
1903	550	—	50	—	—	—
1904	2,100	—	100	—	—	—
1905	3,350	—	500	—	—	—
1906	6,150	—	1,000	—	—	—
1907	9,750	—	1,500	—	—	—
1908	5,700	—	500	—	—	—
1909	12,400	—	400	—	—	—
1910	6,200	—	400	—	—	—
1911	6,100	—	600	—	—	—
1912	9,170	—	*2,600	—	—	—
1913	14,200	—	2,000	—	—	—
1914	13,750	—	2,391	—	1⅛d.	1½d.
1915	6.300	—	1,258	—	¾d.	1⅓d.
1916	9,400	—	12,380	121	1¼d.	1¾d.
1917	7,900	—	5,190	133	—	1¾d.
1918	3,100	—	2,871	855	2¼d.	2½d.
1919	9,500	—	8,000	2,248	—	2¾d.
1920	10,700	—	5,500	3,568	—	3¾d.
1921	19,500	—	12,000	5,405	—	4½d.
1922	4,600	302	10,794	9,974	1¼d.	2d.
1923	4,395	40	12,506	11,235	—	2⅓ to 2d.
1924	7,115	15	18,419	15,689	—	4d. „ 3⅛d.

* Zaria ginnery opened.

A perusal of the table on p. 185 will indicate what progress has been made in developing a cotton export trade from Nigeria during the present century. From the time of their first opening ginneries in the Southern Provinces, the British Cotton Growing Association also carried out experiments in the growing of cotton. This work, however, was handed over to the Director of Agriculture when the Agricultural Department of Southern Nigeria came into being in 1910. In 1912 a sister Department was started in the Northern Provinces, and the writer, who was at that time Director of Agriculture in Uganda, and had already been successful in establishing an improved long-staple cotton in that Protectorate (*vide* p. 429 of *Imperial Institute Bulletin* for 1912), was appointed as its first Director. He took the opportunity of bringing away with him, as personal baggage from Uganda, 60 lbs. of the best available improved Allen seed. This seed was sown at Bida within a week of his arrival in Nigeria in July, 1912 (*vide Imperial Institute Bulletin* for 1913, p. 79). This preliminary trial was so encouraging, that the resulting seed was sown at Maigana near Zaria in 1913, and a further supply of 2 cwt. was obtained through the courtesy of the then newly appointed Director of Agriculture of Uganda. This Allen seed was bulked and was tested against several other exotic varieties, including Georgia, Durango, Cambodia, Nyasaland, and also against the indigenous type of *Gossypium peruvianum*. The results of these trials over a period of three years indicated that, under favourable conditions of soil and cultivation, Allen could not only be relied upon to give the best yield per acre, but also the highest price per pound of lint. It was, therefore, propagated, first of all on a Government seed-farm, and subsequently in selected villages, until seed became available for planting up large areas. At this stage legislation became necessary in order to provide against the exotic seed supply becoming contaminated, either by mixture or hybridization, with the indigenous *Gossypium peruvianum*. An ordinance was therefore passed giving the Governor authority to declare certain districts as "American cotton areas." In these areas no cotton other than the Allen variety was allowed to be planted. In this way it has been possible to establish on a commercial scale in comparatively few years a greatly improved variety of cotton. The actual exports of this long-staple American cotton in recent years, together with the average local purchase price per pound of seed-cotton, have been as shown on p. 187. Last year 5 tons of this most valuable seed were supplied to the Sierra Leone Government, and most satisfactory results are reported, which bid fair to lead to important developments in that Protectorate also.

	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.	1924.
Export, bales of 400 pounds ..	121	433	855	2,248	3,568	5,405	9,974	11,235	15,689
Price per pound of seed-cotton locally ..	1¾d.	1¾d.	2½d.	2¾d.	3¾d.	4½d.	2d.	2½d. to 2d.	4d. to 3½d.

The steady increase in the production from year to year is possibly encouraging, but it must be remembered that the actual volume of the trade is still very small. Compare it, for instance, with that of Uganda. Here an entirely new crop was introduced (for the people of the country formerly clothed themselves with bark-cloth, not cotton). The first bale was exported in 1903. At the time of the writer's arrival in the country in 1909 the export had risen to 5,744 bales, while three years later it reached 27,647 bales of long-staple cotton. Since that time it has increased by leaps and bounds, in spite of marketing difficulties during the war, until last year it reached the very considerable total of 128,604 bales. Why, then, is it that, in a comparative sense, the development of cotton growing for export in Northern Nigeria hangs fire? It was believed some time ago, in certain quarters, that all that was needed to create a great cotton export was improved transport. Yet the railway, which reached Kano over twelve years ago, pierces right through the heart of the cotton belt, but still to-day the cotton output is very small indeed when compared with the population. Even Zaria, the chief cotton-growing province, produces as yet only one bale per 50 head of its population, whereas Uganda averages one bale per 23 souls over the entire Protectorate. The true reason for the relatively slow expansion in Northern Nigeria is to be looked for in causes which may best be described as "agro-economic," if one may be allowed to coin a word to meet the case. Viewing the subject in its broadest aspect, the factors which strictly limit the export of agricultural produce from this great Dependency are, firstly, the total absence of all agricultural implements other than those used in hand-cultivation; and, secondly, the fact that the people are dependent for their livelihood almost entirely upon annual crops, while their rainy season lasts only six months. So long as these conditions exist, it is clear that the man-power of the country must be mainly employed in producing food for local consumption. Some years ago it was hoped that surplus production might be greatly increased by the use of ploughs and other implements drawn by cattle. With a view to exploring the possibilities in this direction, such implements were actually used for several seasons in succession on the Government experimental station near Zaria. These trials led to the following conclusions:—

(*a*) Owing to the baking effect of the dry season on the soil, it is only possible to use the plough for four, or at most five, months in the year, when the rainy season is at its height.

(*b*) Millet—the staple crop of the country—is sown at the beginning of the rains, whilst the ground is still too hard for ploughing, and depends entirely upon after cultivation, but the distance between the rows does not permit of the use of the plough or cultivator.

(*c*) With crops, such as cotton and ground-nuts, which are planted when the rainy season is well advanced, there is a considerable apparent economy of labour in the use of draft animals, but the economies effected are more than offset by the cost and upkeep of cattle and implements. For it was found in actual practice that it was extremely difficult to keep up the condition of the cattle without a good deal of concentrated food, and that animals when run down fell an easy prey to disease.

(*d*) The local system of hand-tillage involves the making of high ridges and deep furrows, which are barred at frequent intervals by cross banks. This practice provides for impounding the rain (which in Nigeria almost invariably falls in heavy showers), and causes it to sink into the soil to the great benefit of crops. The use of implements will not achieve this result. Consequently in times of heavy rain the furrows on the cotton land became rivulets, carrying away enormous quantities of fine soil in suspension and plant food in solution.

For these reasons it was reluctantly decided to abandon the use of draft animals. Apart from these difficulties, there is tsetse fly to contend with over very large tracts of country in Nigeria. It has been suggested, therefore, that motor-ploughs or tractors might meet the situation, but these could hardly prove economical when a yield in excess of 250 lbs. of seed-cotton per acre cannot be relied upon. The capital cost, running expenses, and depreciation would be out of all proportion to the results achieved, for, after the preparatory ploughing, the bulk of the labour would still have to be done by hand.

But any scheme which results in cheapening the food of the people in cotton-producing areas will, almost certainly, be reflected in an increased output of cotton. For this reason, amongst others, the extension of irrigation—for rice during the flood, and for cereals during the dry season—can have nothing but the most beneficial results. In the past it has been too readily assumed that, because the natives of Nigeria have from the earliest times grown considerable areas of cotton to meet a local demand, therefore they would take with alacrity to cotton growing for export. But the point which was overlooked was that the local trade was carried on behind a tariff barrier imposed by lack of transport facilities. The growth of cotton and its marketing under such conditions bore no relation to world prices. Now that the wall is gradually crumbling away with the advent of railways and motor-roads, the hand-weaver has to compete with Lancashire, and cotton grown for export must find its own level in the world's markets. The question of whether Nigeria will produce cotton in comparatively large quantities for export will depend upon whether cotton pays the farmer better than other crops. Let us glance for a moment at the money-crops from which the farmer in Northern Nigeria may make his choice. The chief of these are millet, ground-nuts, and cotton. The following is an estimate of the average receipts and expenditure per acre applicable to these crops, based on twelve years actual farming on a fairly large scale in the Zaria cotton belt. The prices quoted are those obtainable at the present time at any railway station. No allowance has been made for transport to market, as this figure is, of course, a variable quantity:

Crop.	*Approximate Yield per Acre.*	*Present Price.*	*Approximate Value per Pound.*	*Gross Return per Acre.*	*Cost of Production per Acre (Labour at 7d. per Day).*	*Profit.*
			d.	£ s. d.	£ s. d.	£ s. d.
Millet ..	1,800 pounds (in ear)	2s. for 60 pounds	$\frac{2}{5}$	3 0 0	1 6 6	1 13 6
Ground-nuts ..	1,500 pounds (in shell) 1,050 pounds (decorticated)	£10 per ton	1	4 14 0	3 7 6	1 6 6
Cotton ..	200 pounds seed-cotton	3d. per pound	3	2 10 0	1 10 0	1 0 0

It will be seen at a glance that there is not much to choose between these different crops so far as profit per acre is concerned, until the cost of marketing is taken into account. Indeed, the difference is no more than might be covered by an ordinary fluctuation of the market or of the season. But it might be pointed out that, except in the most densely populated areas, the return for a day's labour probably interests the native more than the return per acre, since labour rather than acreage is his limiting factor. From this point of view the same data give the following approximate figures:

Millet	16d. per man-day
Ground-nuts	10d. ,, ,,
Cotton	12d. ,, ,,

This helps us to understand why ground-nuts cannot compete with cotton under Zaria conditions. And immediately one comes to consider primitive methods of transport from outlying districts, which are, of course, enormously expensive when compared with those of a railway, the advantage of cotton is much greater. This explains why around large towns and along the railway one sees mainly millet under cultivation, whilst the cotton fields lie away back in the bush.

An immense internal cash trade is done in millet, which is the staple food of the north. For this reason it is, and is likely to remain, the most important crop throughout the Northern Emirates.

Now let us see what progress cotton has made in Nigeria in comparison with its great competitors for the export trade—ground-nuts in the Northern Provinces and cocoa in the Southern Provinces—since the completion of the railway to Kano in 1912.

	1912.	1923.
Value of cotton lint exported from Nigeria ..	£102,932	£396,549
,, ground-nuts ,, ,, ,, ..	£18,930	£403,059
,, cocoa ,, ,, ,, ..	£130,542	£922,298

It will be observed that, while the output of cotton is nearly quadruple in value, that of ground-nuts has risen from a position of insignificance to one of equal importance with cotton. This is, after all, exactly what one might expect. For since the approximate value per pound of seed-cotton locally is three times that of ground-nuts, it stands to reason that the advent of a railway will favour the less valuable product. A trade in bricks is much more dependent upon a railway than is a trade in diamonds ! But apart from this obvious truth, there is another vital factor influencing the position, namely that as one proceeds northwards from Zaria the natural conditions both as regards soil and climate become less favourable to cotton and more favourable to ground-nuts. That is to say, the soil becomes more sandy, the rains less reliable, and the *Harmattan* (a desiccating desert wind) more intense. Under these conditions American cotton becomes a very speculative crop, but ground-nuts thrive exceedingly. It is true that the only attempts made as yet by the agricultural department to grow American cotton at Kano have resulted in moderately good crops, and it is also true that the people of these parts grow large quantities of native cotton. None the less, the writer does not anticipate any considerable expansion to the north of Kano. Confirmation of this view is found in the fact that year by year the people in these most northerly parts of Nigeria grow large quantities of ground-nuts and bring them south to sell at Kano at 1d. per pound, whereas they buy seed-cotton in competition with the firms who are buying for export, and, moreover, are willing to pay a price that is often in excess of the export value. But how, it may be asked, is it possible for the hand-weaving industry of Northern Nigeria to compete even at places on the railway with the looms of Lancashire? In reply one may well put the complementary question—Why do we British attach such great importance to our textile trade? The answer to the two questions is one and the same. It is because so many people rely upon making a living out of handling the cotton between the time it leaves the grower and the time it is offered to him again as Lancashire cloth!

The buyer, the ginner, the railway, the shipper, the broker, the spinner, the weaver, the dyer and again the shipper, the export house, and probably last but not least the petty trader, not to mention others, are all hungrily waiting to take their pound of flesh. Behind this protective wall of profits the weaver in Nigeria is enabled, with no overhead charges, peacefully to pursue his trade. The time must surely come when cotton manufacturing machinery, erected in West Africa itself, will ultimately kill this hand-industry. But in the meantime it manfully struggles on, producing a durable cloth for those able to afford it. But we must return once more to consider production.

If, then, the farmer, as things are at present, often grows ground-nuts in preference to cotton, it would surely be a case of the triumph of hope over experience to expect that the advent of a railway would cause him to alter his practice, unless at the same time the relative prices of cotton and ground-nuts in the world's markets became greatly modified. For surely, after all, the ultimate effect of improving transport facilities the world over is the development of trade and the production of each commodity demanded by modern civilisation in that particular quarter which is economically best adapted to its growth. In this connection it may be noted that a relatively small drop in the world's price of ground-nuts has a much greater effect on local prices, and consequently on the local export, than in the case of cotton, which is no doubt the explanation of the great variation from year to year in the quantity of ground-nuts exported. Another point that calls for mention, but which has been the subject of much misconception in the past, is the question of the replacement of locally manufactured cloth by the imported article and the presumed surplus of raw cotton which, it is said, will in consequence be available for export. This presumption might be true enough if the cotton plant were a perennial. But as cotton is an annual, occupying in Nigeria only six months from seed-time to harvest, it is clear that the producer will vary his production from year to year to meet the local demand. When, therefore, the demand for hand-weaving becomes less, it does not in the least follow that the surplus for export will be increased.

The reader who has persevered thus far may have come to the conclusion that the writer, who has been working on cotton for the past twelve years in Nigeria, is a confirmed pessimist and can hold out no hope for the future of cotton production in that country. This, however, is far from being the case. Indeed, the very fact that in the neighbourhood of Zaria cotton production for export has slowly but steadily increased for several years past indicates that cotton can, under certain conditions, more than hold its own. What, then, are the factors which concern the grower for export?

They are:

1. Yield per acre.
2. Price per pound.
3. Cost of production per acre.
4. Cost of marketing.

If it is desired to raise cotton growing in the estimation of the farmer, it is necessary to improve the position of cotton relative to that of other crops in one or more of the above respects. We have already seen that the mere building of a railway alone will encourage the production of ground-nuts rather than that of cotton. So far as cost of production (expressed as man-power) is concerned, it has not yet been found possible to improve on existing methods. It is in yield per acre and price per pound that much has already been achieved, and that more may still be done. It is, moreover, an actual fact that only where the Department of Agriculture has succeeded in establishing the improved American cotton has any progress whatever been made in the last twelve years in the production of cotton for export. Upon what, then, do these two all-important points of yield per acre and price per pound depend?

Yield depends upon the following five factors at least:

1. Heredity.
2. Climate.
3. Soil.
4. Insect pests.
5. Fungoid diseases.

The most important factors governing the price of seed-cotton are:

1. Percentage of lint.
2. Length of lint.
3. Strength of lint.
4. Uniformity of lint.
5. Cleanliness and freedom from foreign matter.
6. The law of supply and demand in the world's markets.

The five factors governing yield might be regarded as comparatively simple, could they be dealt with one at a time, but it is found that in actual practice they form one extremely involved complex. Thus we may control heredity by selection. We may regulate climate to some extent by adopting the most suitable season for planting, or by irrigation. We may regulate soil within certain limits by manuring and cultivation. Measures of control for insect pests and certain fungoid diseases are also well known. But when all these different factors are acting, interacting, and reacting upon one another, the problem of controlling yield with any certainty from year to year becomes one of inextricable complexity. One example will indicate what is meant. Take the climatic factor. This affects the plant directly through its leaves, indirectly through the soil; again by its effect on insect pests which do direct damage to the plant; again by its effect on insect pests acting as carriers of bacterial and fungoid diseases; and yet again by its effect upon these bacteria and fungi themselves! It is needless to labour the point. Suffice it to say that though the Northern Provinces are probably, generally speaking, inferior to the Southern as regards soil and climate in so far as their direct bearing upon the cotton plant is concerned, yet on account of the southern climate being at the same time more favourable to insect pests and fungoid diseases, its resultant suitability for cotton production is greatly reduced.

As regards the prospects of cotton growing by irrigation, I fear there is not much hope of success, as during the dry season the nights are for the most part too cold; moreover, any water available at this season could probably be much more profitably employed in raising onions or wheat. There is just a possibility, however, that irrigation might in certain instances be employed either at the very beginning or the very end of the rainy season, or both, to prolong the growing season by a few weeks, and so make cotton growing less dependent upon the vagaries of the season.

When we come to consider the six factors influencing the price of seed-cotton, we find ourselves on much surer ground. The percentage of lint to seed-cotton is, of course, a vital factor, for upon it largely depends the price which the ginner is able to offer the grower for his crop, since cotton-seed in the interior of Africa is of relatively negligible value. Length, strength, and uniformity of lint are also all factors which are malleable in the hands of the plant breeder. All these four factors have been receiving the constant attention of the Department of Agriculture in the Northern Provinces ever since Allen cotton was adopted for general cultivation. The plan adopted has been the yearly selection of individual plants of outstanding excellence, their subsequent expurgation under the searching system of progeny tests, followed by the segregation and propagation of the choicest only. The results obtained are, as would be expected, increasingly gratifying, but hitherto the facilities for carrying out the system have been inadequate owing to paucity of botanical staff and the lack of really large Government controlled seed-farms. The Empire Cotton Growing Corporation are fully alive to our needs, and are making arrangements to assist financially in the establishment of the necessary seed-farms.

As regards cleanliness and freedom from foreign matter the cotton of Northern Nigeria always stood high, but has been even further improved during the past three seasons by a most admirable system of compulsory grading which has been introduced. We have discussed at some length the past and present position of cotton production in the Northern Provinces. We have seen that, in the area known as the Zaria cotton belt, cotton is able to hold its own in competition with ground-nuts as a crop for export. This is considered by the writer to be largely due to the fact that the soil here favours cotton rather than ground-nuts. What now are the prospects for the future? In order to consolidate the position already held in the Zaria area, and to achieve a like success over a larger area, it is absolutely essential still more to increase the yield and the quality of the crop, and therefore the profit to the grower. Rapid expansion must not be looked for, but steady progress may be expected.

Let us now consider the position in the Southern Provinces.

Here for the past twenty years cotton has been purchased without any system of central markets or inspection, and a flat rate has been paid for all cotton brought in. Cotton of the most atrocious quality has been purchased at the same price as the better grades. The result has been, as one would expect, steady deterioration. For no astute man would bring in clean cotton for sale if he could obtain an equally high price for a second-grade article. In recent years, in fact, the cotton of Southern Nigeria has only been saleable with difficulty. Happily this deplorable state of affairs has now been brought to an end by the institution, last year voluntarily and this year compulsorily, of Government grading in all the principal cotton-buying districts. By reference to the table given earlier in this article it will be observed that the production of cotton for export from the Southern Provinces has remained practically stationary for the past twelve years. Only in 1921 was there a sudden spurt due to the unprecedentedly high prices then ruling, thus indicating clearly that the problem of increasing the cotton output is really quite as much financial as agricultural. During this same period, however, the export of cocoa rose from £130,542 to £922,298 in value, and from 3,390 tons to 32,822 tons in quantity!

For a proper understanding of the significance of these figures it is necessary to point out that the area from which this greatly increased quantity of cocoa has been drawn is, in the main, the very one from which the British Cotton Growing Association drew most of their cotton supplies twelve years ago, namely, that extending for 25 miles on either side of the railway from Lagos, via Abeokuta and Ibadan to Oshogbo, which lies about 180 miles from the port. As one proceeds from the sea-board inland, it may be said that the conditions gradually become less suitable for cocoa and more suitable for cotton. Thus there has been witnessed, during the last twelve years, the gradual advance of cocoa in the coastal belt and the steady withdrawal of cotton. This movement of the centre of southern cotton production, from the littoral, has this year been recognized by the Association in the removal of their two most southerly ginneries, from Abeokuta and Eruwa Road respectively, to Dutsin Wei and Gusau in the Northern Provinces. Climatic conditions preclude the possibility of cocoa continuing its northward march much further. The question now is whether cotton can maintain or improve its present position in the Southern Provinces in the face of competitors other than cocoa. The chief of these are yams and maize.

It must be remembered that the area we are considering contains some of the largest towns in tropical Africa, namely Lagos, Abeokuta, Ibadan, Oyo, Ogbomosho, Iwo, and Ede. These combined have a total population of 616,366 souls.

Ten years ago their joint population was only 520,602. It will thus be seen that there is an increasing urban population to be fed. These towns draw their supplies by rail from as far north as Jebba (300 miles). It thus appears that, in close proximity to the railway, low-priced crops, such as yams and maize, pay the farmer at least as well as cotton, and probably rather better. When this factor is considered, together with the greatly increased output of cocoa, it is indeed remarkable that cotton has held its own to the extent which the ginning returns show. Hope for the future would appear to lie at some little distance back from the railway. And here again the quantity produced will depend upon the price which the ginner can afford to offer the producer, which brings us back again to the importance of improving the yield and quality of the cotton grown. During the past twenty years many different types of exotic cotton have been introduced from abroad for trial in the Southern Provinces. Who can tell how many insect pests, not to mention bacterial and fungoid diseases, were introduced with this heterogeneous collection ? Suffice it to say that not one of these varieties has been taken up by the local farmer, who still seems to prefer his *Gossypium peruvianum,* producing a staple for which there is little demand in Lancashire. During the past two seasons the re-organized Department of Agriculture has carried out most exhaustive experiments—cultural, botanical, entomological, mycological, and chemical—in the endeavour to ascertain what are the controlling factors in the situation.*

In the meantime most careful variety tests have been carried out, both on the Government experimental station at Moor Plantation and also on isolated plots as nearly as possible analogous to those in native cultivation, in order to ascertain what are the relative merits of the Allen, Meko, and Ishan varieties.

Both in 1923 and 1924 the Allen variety has proved itself the heaviest yielder of the three, when grown as a pure culture. A yield of as much as 1,200 lbs. of seed-cotton per acre, without the aid of manure, was registered on one quarter-acre plot in 1923, while in 1924 a yield of 600 lbs. has been obtained in one case, and 400 lbs. per acre is by no means unusual. These yields are actually in excess of what is generally obtained in the Northern Provinces. The local practice of the Yorubas, however, is to grow cotton, not as a sole crop, but thinly amongst yams or with corn, and it is just possible that for this purpose the tougher indigenous cotton is the better adapted. This point has still to be elucidated. But, again, it must be remembered that Allen seed, acclimatized to Yorubaland, has never yet been offered to the Yoruba for trial. It is quite likely that when he realizes its possibilities he may be prepared to bestow more attention upon it.

We have reviewed the position in the North and the South, but there still remains the central belt of Nigeria to be considered. This is the strip some 120 miles wide, extending roughly from Lokoja to

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* For details, the reader is referred to the Annual Bulletins of the Agricultural Department (1922-1925).

Minna, including Ilorin, the Nupe Province, and the whole of the Benue Valley. It is a part of the country which is, on the whole, thinly populated, and has hitherto produced singularly little for export in proportion to its area. There is every reason to hope that the Allen variety of cotton will here gradually displace the less desirable indigenous types, as, in fact, it already has done throughout Nupe. There is, however, in parts of this area quite a good type of indigenous cotton classed botanically as *Gossypium vitifolium*, of which that known as " Ishan " is a type. Care is being taken thoroughly to investigate the possibilities of improving this type by selection, and of extending its area, before coming to a decision as to whether it could more profitably be replaced by the American long-staple variety, or by a choice type of *Gossypium peruvianum* from South America, which might possibly prove well adapted to the peculiar local conditions of the riverain provinces of Nigeria, favouring as they undoubtedly do, in some respects at least, a cotton of the strong arboreous character of *Gossypium peruvianum*.

It remains for the future to unfold whether Nigeria will ever become one of the world's great cotton-producing countries. But, in any case, cotton production is now, and is likely increasingly to be, of great economic importance to Nigeria herself. A steady increase in the export of American long-staple cotton is practically assured.

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LIVERPOOL COTTON "FUTURES" CONTRACT

BY

A. BRYCE MUIR

Ex-President Liverpool Cotton Association.

[A fully detailed account of the general purposes, functions, and methods of working of the Liverpool "Futures" Contract was read at the Empire Textile Conference held at the British Empire Exhibition in June, 1924, by Mr. A. Bryce Muir, whose knowledge of this somewhat intricate question stands unrivalled. It has already been published in various journals—*e.g.*, in the *Journal of the Textile Institute* and the "Annual Review of American Cotton," published by the *Manchester Guardian Commercial* in August, 1924, and it would be a work of supererogation to publish it again, desirable though it would be. Asking Mr. Bryce Muir whether he would be so kind as to give us a more elementary article for growers, to whom a detailed knowledge of the subject is not essential, he very kindly gave us the following paper, which has already been published in pamphlet form for the British Empire Exhibition, a publication which will necessarily be more or less fugitive. With the aid of this article the cultivator should be able better to understand the system of dealing in "futures."—ED.]

THE first purpose of the Liverpool Cotton "Futures" Contract is to protect those engaged in the industry, mainly as merchants, distributors and manufacturers, against violent fluctuations in price. They can insure, or protect themselves, against appreciation or depreciation by buying or selling cotton for "future" delivery to the weight of their forward commitments.

All the world use cotton goods. The amount they require may be influenced by high or low prices, political peace or disturbance, by the fluctuations in the volume of their trade. In other words, the volume of demand varies widely from time to time.

Cotton is a delicate plant; it is liable to many climatic troubles in its career, and it is liable to serious damage from insects. Consequently, the volume of raw cotton produced varies widely from year to year.

The result of this wide variation in supply and demand is wide fluctuations in price.

The "futures" markets have become a beautifully balanced machine which reflects the world's cotton conditions and requirements. The ruling prices of "futures," from day to day, and from hour to hour, govern the market price of raw cotton all over the world.

The Liverpool Cotton "Futures" Contract calls for 100 bales of 48,000 lbs. weight of American cotton. The basis of the contract is the average grade of the average American crop (Universal Middling Standard equal to Liverpool Fully Middling). The cotton must be delivered in Liverpool during the month for which the contract calls, and there are very detailed rules and regulations governing this fulfilment of the contract. All contracts are subject to the Articles and Rules of the Liverpool Cotton Association. Sellers may deliver better cotton than the quality called for, or cotton of less value (with a stipulated minimum). The buyer must take the quality tendered at its relative value on the day of tender. This value is determined by professional arbitrators, with appeal to a committee of specialists elected for the purpose. By making the basis of the contract the average grade of the average crop, it is felt to be fair to both buyer and seller.

A spinner wishing to buy a given quantity of cotton per week, for three months ahead, against a sale of yarn over a similar period, can, on fixing the price of his yarn, buy an equal weight of cotton for future delivery in the months he requires it; thus he is independent of any fluctuation in price, for he has based the price of his yarn on the price at which he could buy his cotton for future delivery.

When each month comes round, he can sell out his future delivery contract and simultaneously buy the particular quality of raw cotton he requires, basing his purchase on the price at which he sells his "futures" contract. If the market has meanwhile advanced, he pays the advanced price for his quality of raw cotton, but as his "futures" contract has also advanced, the profit he makes on it goes to reduce the amount he pays for his raw cotton. Similarly, should prices decline, he buys his raw cotton at a price relative to the decline, but adds to the price the loss incurred by his purchase of "futures." Therefore, so long as he transfers his "future" contract into an equal weight of the particular quality of raw cotton which he requires, at the price ruling at the time, he has been able to eliminate intermediate fluctuations.

Merchants who import cotton similarly "hedge," or protect themselves against fluctuations in price, by selling an equal weight of "futures" at the time they purchase their cotton. When they sell the raw cotton, graded and selected for the particular requirements of various spinners, they simultaneously buy back their "future" contract sales; or they may sell cotton for delivery ahead over several months to a spinner, at a fixed price, and they protect themselves by buying "futures" of an equal weight, selling out their

" future " contracts as they purchase the particular qualities of the raw cotton they require. These are two simple illustrations of the principle of " hedging with futures " as a protection against fluctuations in price. All branches of the " trade " are in the habit of " hedging " and so markets become active and free.

It is obvious, however, that it is imperative that one should be able to buy and sell " futures " contracts freely and at a " close " price if hedging is to be satisfactory. . . . This free trading is provided by professional operators who spend a strenuous life in providing such facilities—not out of public spirit (!) but as a means of livelihood. There are jobbers, as on the Stock Exchange, dealers, who buy when they think the market is too weak and sell when they think it too strong, and straddlers, or arbitrage operators, who watch closely the relative values of the New York, New Orleans and Liverpool " futures " markets, by their operations keeping them in relation to each other. Speculators buy when prices are down too low, in their opinion, or sell when too high.

Fluctuations are based on pence and hundredths of a penny per lb. In normal markets one can trade quite freely within 1/100th of a penny per lb. A jobber will offer to buy, say, 100 bales of cotton 48,000 lbs. weight at $17\frac{25}{100}$d. per lb., or sell a similar quantity at $17\frac{26}{100}$d. per lb. One could hardly wish for closer trading. It means that on a contract worth £3,450 a jobber will make a price within £2. He is willing to buy at £3,450 or sell at £3,452. This illustrates the extraordinary freedom of trading in " futures " as a result of all the trade using " futures " as a hedge for their transactions.

Other trades are now developing trading in " futures," for they realize that by eliminating the risk of price fluctuation business can be cut to very fine margins of profit and the turnover enormously increased.

THE
IMPROVEMENT OF THE COTTON CROP

BY

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THIS article embodies a survey, in some detail, of the problem of the improvement in yield and quality of the cotton crop. This survey was prepared with special reference to conditions in India, but as in its broader aspects it is of more general application, it may be of interest to others outside that country.

ANALYSIS OF THE PROBLEM.

Beginning at the point in which the grower is most interested, and which it is the final aim of research work to influence favourably —viz., the value of the crop per acre—and working backwards, the following analysis of the problem is arrived at.

Value of Crop.—The value of the crop per acre depends upon the yield per acre and the price, which, in the main, depends upon the quality of the produce (lint).

Yield per Acre.—This depends upon the number of plants per acre and the yield per plant. Each of these factors in turn depends upon the interplay of hereditary characters and environmental factors.

Quality.—The quality of the produce similarly depends upon the interplay of hereditary characters and environmental factors.

Hereditary Characters.—1. Those which affect the yield per plant are:

(*a*) The number of bolls per plant.
(*b*) The number of loculi per boll.
(*c*) The number of seeds per loculus.
(*d*) The weight per seed.
(*e*) The weight of lint per seed.

(*a*) The number of bolls per plant depends upon the habit of the plant, the length of term, and the vigour of the plant.

The Habit of the Plant.—Under this head are included the height of the plant, the number of vegetative branches developed from the axillary buds on the main stem and from the accessory buds if such develop, the number of fruiting branches borne on the main stem and on the vegetative branches, the number of nodes on the fruiting branches, the length of the internodes, the angle at which the branches are carried in relation to the main stem, and the toughness of the wood. The last three characters affect the ability of the plant to carry its crop to harvest without breaking down before the bolls mature and burst. The others determine the number of flower buds produced.

The Length of Term.—This is affected by the habit of the plant (a plant which produces its first flowering branch low down the main stem will flower earlier than one which does so high up the stem), but also depends upon the rate of growth of the main stem, the vegetative branches, and the fruiting branches; the interval between the appearance of the bud and the opening of the flower, and the interval between the opening of the flower and the bursting of the boll.

The Vigour of the Plant.—By this general term may be described the constitutional ability of the plant to withstand excess or defect of moisture, to resist the attack of pests and diseases, and to mature a high proportion of bolls to buds produced. In this connection the rooting system of the plant and the development of the anthers are probably factors of importance. The presence or absence of hairs on the leaves is certainly of importance in relation to the attack of the Jassid (*Empoasca devastans*).

(*c*) *The Number of Seeds per Loculus.*—This is affected by the number of loculi per boll, and may depend on the number of ovules per loculus and on the size of the loculus.

(*e*) *The Weight of Lint per Seed.*—This depends upon the number of hairs per seed and the weight per hair. The latter depends upon the length, cross-section, and specific gravity, characters of importance affecting the quality of the lint.

2. Characters which affect the number of plants per acre are—the habit of the plant, which determines the amount of space required by the plant in order to develop fully; length of term, which affects the amount of space desirable to allow the plant under given conditions; and vigour, which affects the ability of the plant to survive.

3. Characters which affect the quality of the lint.

The most important of these, from the point of view of the producer of raw cotton, are: length, strength, fineness, colour, lustre, and uniformity in each of these. The other characters, such as porosity, extensibility, etc., are not such as are simple of determination, and are better dealt with in a technological laboratory.

4. Other characters. Besides the above-mentioned characters there are others, such as the colour and the size of the flower, the size and shape of the leaf, the presence or absence of nectaries, etc., which may or may not have any connection with the yield of the plant or the quality of the lint, but which are useful identification marks, and enable workers to judge easily whether mixture is taking place either in the breeding plots or in the cultivators' fields.

Environmental Factors.—These affect the yield per plant, the number of plants per acre, and the quality of the lint. They are:

(*a*) Climatic conditions.
(*b*) Pests.
(*c*) Diseases.
(*d*) Water.
(*e*) Soil.
(*f*) Manure.
(*g*) Methods of cultivation.

(*a*) *Climatic Conditions.*—Under this head are included rainfall, temperature, humidity, sunshine, cloud, and wind.

(*b*) *Pests.*—The chief pests are: The pink and the spotted boll worms, the stem weevil, the stem borer, jassids, aphis, the dusky and red cotton bugs, and certain other sucking insects which are probably instrumental in spreading fungoid and bacterial diseases.

(*c*) *Diseases.*—These are fungoid—*e.g.*, wilt (*Rhizoctonia*); bacterial —*e.g.*, black-arm (*B. Malvacearum*); and physiological—*e.g.*, red leaf disease.

(*d*) *Water.*—The effect of irrigation on a cotton crop depends on the amount of water given, the time and method of application, and on the composition of the water.

(*e*) *Soil.*—The fertility of a soil depends on its texture, depth, and composition, which last term covers the whole soil complex, organic and inorganic ingredients, and living organisms.

(*f*) *Manure.*—The effect of manure on a cotton crop depends on the kind and quantity applied, and on the time and method of application.

(*g*) *Methods of Cultivation.*—Under this term are included the various methods of preparing the land for the crop, sowing the seed, cultivating the crop after the seed has germinated, and the various rotations of which the cotton crop forms a constituent.

From the foregoing it is evident that a complete scheme of agricultural research, aiming at the improvement of the cotton crop in regard to yield and quality of produce, may be divided into two main divisions. In the one will be included matters concerning the heritable characters of the plant, and their mode of inheritance, and in the other matters concerned with the environment.

Before proceeding to discuss in detail these two divisions, it is well to draw attention to two important considerations. First, in the case of the heritable characters, while their expression in the plant is affected by the environment, and while as characters they cannot be altered by human agency, yet they can be manipulated and made to combine in a manner which will result in some degree in the improvement aimed at. Secondly, in the case of the environment, though some of the factors are within human control and can be varied so as to bring about the desired improvement, others are not. In their case, however, a knowledge of the effect of variations in them is of importance in estimating the effect of variations made in those under control. This knowledge is also necessary to prepare a forecast of the time at which a crop will come to harvest, the yield it is likely to give, and the quality of the produce which will be marketed. The more exact this information is, the more likely is the forecast to be correct.

Turning now to the consideration of these two main divisions, heredity and environment, matters concerned with the former will be taken first.

HEREDITY.

In a study of the inheritance of the cotton plant, there are three processes to be gone through:

1. The recognition of the heritable characters and their definition or method of measurement.

2. The isolation of pure strains in which the heritable characters are combined in various ways.

3. The manipulation of these characters by crossing strains with the object of forming new combinations of characters, and the study of the results obtained.

Items 1 and 2 are generally carried out simultaneously, and together form the foundation of all plant breeding work on cotton. Item 3 is carried out by making crosses between strains of the same or of different species and applying ordinary plant breeding methods.

The more important heritable characters, having an obvious bearing on the economic position, and upon which research should be first directed, are:

Lint.—Length, strength, fineness, colour, lustre, uniformity in each of these, and weight per seed.

Seed.—Weight, size, presence or absence of fuzz, number per loculus.

Boll.—Number of loculi, size, shape, manner of opening.

Leaf.—Presence or absence of hairs.

Plant.—Habit, length of term, vigour.

Other characters, such as colour of flower, type of leaf, presence or absence of nectaries, colour of the fuzz on the seed, etc., are in the light of present knowledge of less importance. Many of them can be studied while dealing with the other important characters.

The chief defects from which Indian cotton suffers are that the staple is short, the average yield per acre is low, and there is frequently too high a percentage of leaf present in the sample. A considerable improvement in the last-named detail could be brought about if the size of the boll were increased and the sectors of the capsule opened more widely. Work on the inheritance of characters should therefore aim at the removal of these defects.

ENVIRONMENT.

Climatic Conditions.—It is well known to everyone who has experience of cotton that variations in climatic conditions have an enormous influence on the yield and quality of the cotton crop. As an extreme example it may be quoted that Cambodia cotton grown under fair conditions in South India will grow to a height of 4 to 5 feet, and will give a yield of 1,000 lbs. of seed cotton per acre, whereas if grown in North India it tends to grow to a much greater height and give no yield. This knowledge of the effect of season on the cotton crop exists, but it is too general and needs to be systematized. As a means of doing this it is suggested that the following scheme should be carried out each year for a number of years.

1. At each Agricultural Station in each important cotton tract a plot of the particular pure strain of cotton evolved at and distributed from that station should be grown as far as possible on similar land and under similar cultural conditions.

2. Throughout the year a daily record of rainfall, temperature, humidity, etc., should be maintained at each of these stations.

3. Throughout the growing season a daily record of flower buds produced and shed, flowers opened, bolls shed and burst, should be kept for a group of plants in each of the plots.

4. A record of the treatment given to the plot and of any occurrence, such as an attack of pest or disease, should be maintained.

5. The yield obtained from the plot should be recorded.

6. A sample of the seed-cotton obtained should be sent to the technological laboratory for a detailed examination of the lint to be made and for a spinning test to be carried out.

By doing this an exceedingly valuable set of records would be obtained. After some years the information collected would make it possible to interpret more accurately the effect of seasonal variations in different parts of the same tract. As a result a more reliable forecast of the probable yield and quality of the cotton from that tract could be arrived at than is the case at present. Moreover, such information is very necessary if the results obtained from experimental work affecting other environmental conditions under human control are to be correctly interpreted. Also this information would be a distinct aid in calculating the chances of success of the introduction of a variety into a new tract.

Pests.—The problem of insect attack offers the following main lines of investigation:

1. Description and life-history of the pest.
2. Habits of the pest, how it spreads, and how it carries over from one crop to the next.
3. The amount of damage caused.
4. Means of control, by enemies, poisons, or manipulation of the crop.

The description and life-histories of the more important of the insect pests of cotton in India are fairly well known. More detailed information in regard to items 2, 3, and 4 is needed, more particularly if local authorities are to be convinced of the need for legislative measures.

Except in the case of the Jassid, where the possession of hairs on its leaves affords to the plant a distinct measure of immunity from attack, breeding with the object of evolving resistant strains does not at present seem hopeful. It is, however, definitely known in Madras Presidency that the stem weevil and the spotted boll worm, and possibly the pink boll worm, show a decided preference for Hirsutum cottons as compared with the indigenous species. The reason for this is not known, but must lie in some constitutional difference between the two species, as both are sown at the same time and are equally exposed to attack. This information, if known, would be a distinct aid to selection and breeding work aiming at the isolation of resistant strains.

Diseases.—Investigation of disease follows similar lines to those indicated for pests.

Where the disease is definitely known to be due to an organism, the most hopeful solution of the problem appears to lie in plant breeding work aiming at the isolation of resistant strains.

Where the disease is known to be definitely physiological, detailed investigation of the soil, the plant, and the conditions of growth is necessary. It may also be possible to attack this problem by evolving strains which are not, or are only slightly, affected by the disease.

Water.—A certain amount of work on the use of water for the cotton crop has been done in India. Where, however, the crop has to depend mainly on the supply of irrigation water, more information as to the quantity of water to be given per irrigation, the number of irrigations to be given in all, and the interval which should elapse between successive irrigations is needed. This problem is, however, inextricably bound up with problems of soil, manure, and methods of cultivation, and has to be considered along with them.

Soil.—As yet only the fringe of the work lying waiting to be done on cotton soils in India has been touched. Broadly speaking, the problem may be considered as falling under the four following heads:

1. Mechanical and chemical analysis.
2. Fauna and flora.
3. Physical properties.
4. Climate.

It is not suggested that definite schemes should be formulated, having as their object the carrying out of wholesale surveys all over India along these four lines. Each may be approached through some definite problem the solution of which will yield results of economic importance. For example, under—

1. There are indications that there is a relation between the quality of a lint, and (*a*) its chemical composition, and (*b*) the chemical composition of the soil on which the crop was grown. Further enquiry is needed to establish definitely the existence of this relationship. If the result confirms this point, the fact will be of importance in devising manurial experiments, and a step towards the solution of the problem of levelling up the quality of the cotton of a tract to a fairly uniform condition will have been taken.

2. The relationship between the soil organisms and the production of nitrates in the soil needs investigation. After soil moisture lack of nitrogen in the soil is the most important factor in limiting the yield of the cotton crop in India. Artificial manures to remedy this defect have either proved uneconomical or involve the possession of more capital than the average cultivator has at his disposal. Experimental work to discover cheap methods of increasing the efficiency of beneficial soil organisms is needed.

3. The investigation of the physical properties of the soil should

go hand in hand with the investigation of problems of plant growth, and of cultural and irrigation problems.

4. The examination of the soil climate is necessary in investigating problems of plant growth—*e.g.*, bud and boll shedding. A knowledge of the relationship between the climate above ground and the soil climate, and the effect of variations in the latter on the plant, would lead to a better understanding of the causes of variation in yield and quality of the crop, the first step in devising means of control.

Other problems will occur to other investigators as the work proceeds. In time the whole field will be covered.

Manure.—A considerable amount of work on the kind and quantity of manure for the cotton crop has been done in India, and some work on the time and method of application. Much work, however, remains to be done.

One of the outstanding manurial problems which has as yet not been solved is the economical manuring of black cotton soil. In certain parts on this soil an increase in the yield of the cotton crop of from 50 to 60 per cent. can be obtained by growing it after a leguminous crop. The introduction of this procedure in practice, however, cannot be recommended. If adopted the area under cotton and grain crops on the cultivator's holding would be reduced from one-half to one-third, and unfortunately the legume cannot always be depended upon to make up the loss on the grain crop. Along this line of attack the problem is bound up with the improvement of the other crops in the rotation. Some other solution may, however, be possible.

Methods of Cultivation.—Much work has already been done in India on (*a*) preparatory cultivation, (*b*) methods of sowing, (*c*) spacing, (*d*) after-cultivation, and some work has been done on rotations and mixed cropping as compared with pure cropping. There is, however, still work to be done along these lines.

A problem of some urgency is that of seed storage and the preparation of seed for sowing. Unaccountable failures of seed sometimes occur. The explanation for this may be in—

(*a*) The condition of the seed when put into the store.
(*b*) The conditions of storage.
(*c*) The treatment given prior to sowing.
(*d*) Soil moisture conditions at the time of sowing.
(*e*) The seed itself.

The question is of importance in connection with the distribution of seed to cultivators.

Received February 12, 1925.

A VENTURE IN COTTON

BY

F. E. PENNY

There is nothing the Englishman in India likes better than a bit of a flutter if he has a little capital available. It is strictly forbidden to the Government employee, but the free lance may please himself.

Edward Anstruther inherited a thousand pounds from a relative. It came unexpectedly, but none the less acceptably. Too small to invest in some gilt-edged security, it was too big to " bust " on a trip home. It was the very thing to warrant a speculation. If he lost it all he would be no worse off than he was before. He would still have the salary he drew from the cotton press at Tuticorin, where he was engaged as one of the management. If he was successful—that big " if " which holds such a power of attraction for the sporting temperament—he would more than double the outlay.

Cotton naturally attracted him. He knew all about cotton, and could see that good money was to be made if any improvement could be effected in the harvesting. The cotton grown in South India has many fine qualities, but it is half ruined by the inadequacy of the labourers. They gather the snowy, fluffy lint with all its dead leaves and twigs, using the palm of the hand instead of the fingers.

Anstruther believed that if he instructed and supervised the people he could make an improvement in the quality and ensure a better price for the raw stuff. He purchased the crop on the land of a certain Zemindar and paid the customary deposit. He chose half a dozen men in the town who were accustomed to act as overseers of labour. They undertook to give the necessary instruction, and suggested that they could do it best without his assistance. If he would tell them what he wanted done they would see to it that his wishes were carried out. He was to be on the spot, their visible authority for all they ordered.

Accompanied by his staff of personal servants, which included Abboy the butler, the cook and cook-boy, and the kitchen woman, Anstruther then proceeded to the scene of operations. The fields were a beautiful sight, the fleecy cotton patching the bushes with snow. If it could only be secured clean and unstained by dust storms or rain his profit would be even more than he had hoped.

He put up at the travellers' bungalow. Although early in the year the days were hot; between sunrise and sunset the sun blazed down from a cloudless sky. The heat set the air quivering like limpid running water; under it the bolls on the bushes burst in profusion and seemed to call aloud for the harvester.

Anstruther was up early. Abboy had provided him with early-morning tea and had added a couple of boiled eggs to the buttered toast, knowing that the big breakfast-lunch would be late.

From the verandah Abboy, with his underlings, watched the master depart. As there was no sign of pickers at present, Anstruther bent his steps towards the village where his maistries were lodged. He wore an enormous mushroom pith hat that protected the back of the neck and upper part of the spine. As a further protection he carried a white umbrella.

Abboy's eyes, deepset under thick, black brows, swept the flat horizon with an anxiety he did not attempt to hide. Near the village was a small grove of palmyras. One of them had never been touched with the knife of the toddy-drawer. The tree was dedicated to a female demon known as an "ammah." She was said to be of a malignant disposition. She held the villagers enthralled, her mouth-piece being the valluvan, the village astrologer and wise man. When the evening breeze swept in from the distant sea her voice could be heard in grumblings and threats as the dry palmyra stalks grated and sawed against each other.

Anstruther's servants were not in sympathy with the "village people," as they termed the inhabitants. They held them in contempt; them and their uncivilized habits, their scanty dress, and their ammah.

Abboy looked significantly at the cook.

"It is as the headman said," responded the cook, who interpreted the glance correctly. "Not a worker in the fields."

"And the cotton spoiling as it stands!" said Abboy with indignation.

"The devil in the palmyra tope has forbidden them to leave their huts," said the kitchen woman. She never failed to glean all the gossip of a place within an hour of her arrival. "To-morrow night a great fire will be lighted in the tope and there will be a devil-dance. The valluvan himself will lead the dance."

"And there will be much drinking," added the cook-boy.

The white umbrella neared the village as its owner plodded over the dark, dusty soil. Roads and beaten tracks are conspicuous by their absence in the South Indian cotton country. Not a soul advanced to meet him. The half-dozen maistries brought from Tuticorin rose from the platform that marked the centre of the hamlet at his approach. They salaamed respectfully.

"Where are your gangs of workers?" demanded Anstruther, not in the best of tempers. Every hour made a difference.

"They refuse to turn out. We have threatened them with fines and a good beating with the bamboo, but it is of no use. They all say the same. Their tree-devil has forbidden them to work. To-morrow, Friday, is their usual day for devil-dancing. On Saturday they will sleep after much drinking. On Sunday, or perhaps Monday, they say they will pick cotton all day long, if master please."

"I don't please!" shouted Anstruther. "By that time half the lint will have blown away; and if we get a dust storm all will be hopelessly damaged. Where's the headman?"

A venerable old Tamil came forward at once. He salaamed low and turned his hands palms uppermost. He could do nothing, he assured the highborn lord of magnificence. He called himself a worm, a lump of mud! He threw himself figuratively before his lord's pious footsteps and prayed for mercy! He could do nothing!

Abboy knew exactly what was happening. Half an hour later the white umbrella was seen leaving the village as solitary as it entered it. Its bearer was realizing the fact that he was up against that Juggernaut of India—superstition—that nothing can move, no matter how imperative may be the need for prompt action. Not a finger would be lifted to save the crop until the drug-besotted valluvan, who constituted himself the mouthpiece of the devil, had given the word for work; and this he would not do until he had had his diabolical orgy of drink and dance.

"The master will be vexed and troubled," remarked Abboy.

"And he is a good master," replied the cook. He turned to the kitchen woman and addressed his next observation to her. "Two moons have gone since our honoured butler cast the devil out of one of the machines in the Eastern Cotton Press."

"He has much power over devils," responded the woman with a glance at her virtual master.

Abboy kept silence. In addition to his employment as head-boy or butler to Anstruther, he had a secondary trade that brought him in small sums. He professed to be able to cast out devils and exercise some control over the spiritual world of Hindu demons. It was one thing, however, to deal with detached elementals that possessed human beings and worked mischief in various ways, and quite another to tackle an established ammah that had had a regular habitat from time immemorial in a tree. The conversation was becoming too personal, even though it was of an adulatory nature. The head servant turned suddenly on the cook-boy.

"Son of a dhoby donkey! why art thou not boiling the water for the master's bath? See! he comes—and not in the best of tempers. Assuredly he will lay his stick across thy back if he catches thee here."

The boy scurried off to the kitchen to escape the clout over the head from the butler that usually accompanied orders of the kind. The woman rose also.

"I go to see that that mudhead of a boy does not use too much wood in heating the bath water."

The cook and the butler looked out once more. The only person visible throughout the length and breadth of the fields was the master. A whirlwind had risen not far from the palm trees like a column of smoke. It gathered up dry leaves and waltzed off over the cotton, powdering the white bolls with dust and rubbish. The villagers watched it silently. In it rode the ammah, according to the valluvan.

It was a weary day for Anstruther. At sunset the Assistant Police Superintendent of the district rode up to spend the night at the dak bungalow. Into his sympathetic ear Anstruther poured his tale of woe.

"I suppose you are not working with any contract."

"No; I never dreamt that such a course would be necessary. I don't quite see how I could make a contract."

"You couldn't," responded the Police Officer. "Neither the headman nor the Zemindar would accept any responsibility. They know that their authority would go for nothing when it was a case of opposition from the ammah."

They had dined and were seated in the verandah. A breeze blew in from the distant coast and the air was cool and refreshing after the swelter of the day. A few dim lights still glimmered in the village. The evening meal had been taken, and the villagers were already rolling themselves in their sheets and seeking their sleeping mats under the eaves of the huts. The women were stacking the cooking pots where the unclean dog and jackal could not get at them.

Suddenly a weird, prolonged scream burst on the ears of the Englishmen. It came from the direction of the palmyra tope.

"A hawk-owl!" exclaimed Anstruther. "I've never heard the devil-bird before. It's like a man having his throat slowly cut."

"I've heard it," said the Assistant Superintendent. "That scream is not the scream of the devil-bird."

He stood up, roused by an instinct of duty. If a crime were being committed it was his business to mark it down.

Again the cry came, longer and with a curious wail at the end that was not the shriek of physical pain. The Assistant Superintendent sat down again and helped himself to another cigarette.

" This is some hocus-pocus of the village valluvan whose business it is to personate the devil. I don't think I need trouble about it; it's not a case for the police."

Anstruther called for his servant. The kitchen woman came in answer. She was trembling. The ammah was a reality to her although she was not a worshipper.

" Where's the butler ? Send him here."

" Taking rice, sar," replied the woman.

" As soon as he has finished send him to me. I want him to find out what is going on in the village. Who was screaming ? Do you know ?"

Before she could reply the sound was repeated once again.

" The ammah ! the ammah !" she cried. Covering her head with her saree she bolted in the direction of the kitchen.

" A call for poojah," remarked the Assistant Superintendent. " No chance of getting your cotton in till Monday."

" Four good days lost ! If there is much deterioration I shall refuse to pay the full price the Zemindar has demanded. Perhaps it will teach him to exercise a little control over his village people."

" Easier said than done in these days," rejoined his companion.

Strange sounds came from the direction of the palmyra grove. The villagers had heard the call and had risen, heavy with sleep, from their mats. From the palms came an unearthly voice, louder and more penetrating than any known human voice. The screams became articulate. Poojah was demanded with an offering of goats. It was to be a big poojah that was to last several nights. But first the cotton crop must be harvested. No poojah would be permitted with the foreigner in the dak bungalow.

" Gather the crop ! Pick the cotton with care and let the stranger take it away with him. Then only will I drink blood while my people fill themselves with toddy !"

To a man the crowd gathered together before the tope and fell on their faces, grovelling in the dark, dusty soil as they promised abject obedience. While they so remained, their mouths and eyes covered with trembling hands, a figure emerged from the other end of the grove. His dark body was naked except for the small loin cloth bound tightly round his hips. Swiftly he ran towards the dak bungalow.

A few minutes later Abboy stood behind his master's chair, clothed in his white garments of service. His chest heaved, but he controlled his quickened breath.

"Master asking for me?" he said quietly. "Very sorry, sir; I was taking rice."

"Yes, Abboy. I want you to find out the meaning of that awful screaming in the village. You heard it?"

"Yes, sir. It was the ammah talking to the people."

"What was she saying?"

"Telling them to do plenty poojah. Shall I bring soda-water and whisky?"

The Assistant Superintendent eyed the man keenly, but said nothing till he had gone on his errand.

"By the way, Anstruther, you mentioned that you thought of teaching these villagers a better method of picking the cotton. How were you going to do it? In classes?"

"That was my intention, and I got out from home a loud-speaker for the purpose. I don't think I shall want it, however. The maistries can do the teaching better than I can."

The Police Officer smiled, but kept his thoughts to himself.

The following morning, to Anstruther's intense astonishment and satisfaction, the whole village turned out into the fields and picked cotton from sunrise to sunset. In forty-eight hours the crop was harvested and packed off in village carts to the railway. Anstruther paid his labourers and returned with his gang of maistries to Tuticorin.

Abboy kept his secret. He claimed to have influence with the ammah, and preferred to have the reputation of possessing power over devils to making any explanations. He is still in Tuticorin, a highly valued servant and a notable caster-out of evil spirits.

This entertaining sketch by Mrs. Penny, the well-known writer, with her twenty-four years' experience of South Indian life, gives an insight into one of the difficulties—superstition—that in the East confront the agricultural or other worker who is burning with enthusiasm for improvement. Two cases, at least, where superstition rendered nugatory much work for agricultural improvement, occurred during my residence in Ceylon.—Ed.

SPINNING TESTS

UGANDA COTTONS.

TESTS on five samples of Uganda cottons received from the Department of Agriculture and grown at the Government Farm, Serere, have been carried out with the co-operation of the British Cotton Industry Research Association.

The following is a description of the tests applied, together with a description of each cotton as supplied by the growers, and the results of the laboratory examination and of the spinning tests.

The five samples sent were examined and divided into two groups. The first group, N.21, Webber, and S.7, were put through Spinning Test E. and were compared with Ordinary Memphis cotton. The second group, N.17 and A.2, which are better cottons than the others, were put through Spinning Test F. in which they were compared with Memphis " Extras." Details of the two Spinning Tests are given below.

MEASURABLE CHARACTERS.

" Staple length " is defined as the most frequent hair length occurring in a representative sample of the cotton. English measure given to the nearest $\frac{1}{32}$ inch.

Lustre.—The intensity of the light reflected at an angle of 45° to the normal of a pad of cotton hairs is measured (*a*) when the angle of incidence = 0°, and (*b*) when this angle = 45°. The lustre is then defined as:

$$\frac{\text{Intensity of light in } (b) \text{ position}}{\text{Intensity of light in } (a) \text{ position.}}$$

The symbol $\mu = \frac{1}{1{,}000}$ mm. = 0·0000394 inch.

SPINNING TEST E.

The standard counts spun in this test are:

1. 44's Twist with 23·74 turns.
2. 54's Weft with 23·74 turns.

Additional counts are spun when thought desirable.

As a basis for comparison in the case of those cottons given Test E. the following are the results of tests carried out on a commercial sample of Memphis cotton (1923 crop) of similar staple, and spun under identical conditions.

Test.	*44's Twist,* 23·74 *Turns.*	*54's Weft,* 23·74 *Turns.*
Single Thread Strength in grams	127·3	96·7
Extensibility per cent.	5·9	4·9
Ballistic Strength in inch-pounds/lea	46·1	33·2
Actual turns per inch	23·03	21·98
Variability per cent. by Single Thread Tests ..	9·2	12·7

SPINNING TEST F.

The standard counts spun in this test are:

1. 62's Twist with 28·5 turns.
2. 64's Twist with 28·66 turns.

Additional counts are spun when thought desirable.

The following are the results of tests carried out on a commercial sample of Memphis Extras (1923 crop) of similar staple, and spun under identical conditions.

Test.	62's *Twist,* 28·5 *Turns.*	64's *Twist,* 28·66 *Turns.*
Single Thread Strength in grams	105·7	98·6
Extensibility per cent.	5·9	5·5
Ballistic Strength in inch-pounds/lea	40·0	36·4
Actual turns per inch	28·0	31·9
Variability per cent. by Single Thread Tests	8·7	8·4

SPINNING TEST REPORTS.

Growers' Particulars for All Five Samples.

Cultivation.—The land was broken up out of jungle in 1922 and cropped with cotton in that year.

Cultivation consisted of ploughing with a double-furrow disc plough, and harrowing with a disc harrow.

Dates of Sowing: From June 22 to August 15, 1923.

First Flowers: Between September 15 and 25.

Diseases and Pests.—Slight attack of ordinary bollworm in December, and slight mildew on leaf. Some damage by stainers in February after abnormally heavy rains.

Abnormal Conditions.—The abnormally heavy rains mentioned above also spoiled the general appearance of the samples, and were responsible for the slight brownish tint observable in some of them.

Picking Dates.—Began December 1; general by 24th.

Further Particulars.—The above cotton was grown last year (1923) for the first time in Uganda, and has not been selected in any way.

VARIETY: SUNFLOWER. (MARK: S.7.)

Grower's determination of (*a*) Yield, 696 pounds seed cotton per acre; (*b*) ginning outturn, 32·5 per cent.; (*c*) staple length, 1⅜ inches.

Results of Laboratory Examination and of Spinning Tests.

Measurable Characters.

Staple length	29·46 mm. = 1 $\frac{5}{32}$ inches.
Breaking load	4·37 grams.
Hair-weight per cm.	0·00142 mgm.
Hair width	15·77 μ.
,, ,, mercerised	12·88 μ.
Lustre factor	2·48.

Spinning Test: Test applied, No. E.

Total waste up to card sliver = 10·3 per cent.

Owing to the stripping of the card before each sample is put through, the waste loss figures are exaggerated and do not represent the losses to be expected on a commercial scale.

Strength Tests: Yarn.

MEAN RESULT.

Yarn : Nominal Description.	*44's Twist,* 23·74 *Turns.*	*54's Weft,* 23·74 *Turns.*	*50's Weft,* 20 *Turns.*
Observed Counts	45·7	52·6	49·8
Observed Twists	25·77	26·68	25·12
Observed Lea Strength (pounds) ..	39·5	29·9	34·8
Lea Strength at Nominal Counts (pounds)	41·1	27·4	33·7
Ballistic Strength at Nominal Counts	49·8	34·4	42·6
Single Thread Strength (grams) ..	143·8	109·3	118·3
Variability, per cent.	9·0	12·2	9·6
Extension, per cent.	4·46	4·90	4·80

REMARKS.

1. When the 44's Twist and 54's Weft were being spun with American turns, it was observed that the cotton spun very tight, and from this it was judged that it could do with less twisting. It was, therefore, spun to 50's Weft with Egyptian turns, with the result as shown above. This capacity for spinning satisfactorily with less twisting means that to obtain a yarn of given strength a greater production per spindle per hour is possible, with its resultant lowering of production costs. The reason for this is probably due to the fineness of the cotton as compared with Memphis, and on the same account also it is reasonable to expect it to spin to slightly higher counts.

2. Of the three cottons—N.21, Webber, and S.7—this cotton would be classed lowest by a broker or spinner. The figures show it to be the weakest, but in regularity it appears to be as good as N.21 and better than Webber. It makes a stronger yarn than the Memphis cotton by about 12½ per cent.

3. It is a good lustrous and desirable cotton, and would certainly have a market if obtainable in bulk. The yarn was very clean and level for a carded quality, and was equal to N.21 in this respect.

VARIETY: WEBBER LONG STAPLE UPLAND. (MARK: W.)

Grower's determination of (*a*) Yield, 690 pounds of seed cotton per acre; (*b*) ginning outturn, 32 per cent.; (*c*) staple length, 1¼ inches.

RESULTS OF LABORATORY EXAMINATION AND OF SPINNING TESTS.

MEASURABLE CHARACTERS.

Staple length	29·44 mm. = 1 5/32 inches.
Breaking load	4·62 grams.
Hair-weight per cm.	0·00129 mgm.
Hair width	16·67 μ.
,, ,, mercerized	14·01 μ.
Lustre factor	2·30.

Spinning Test: Test applied, No. E.

Total waste up to card sliver = 15·3 per cent.

Owing to the stripping of the card before each sample is put through, the waste loss figures are exaggerated and do not represent the losses to be expected on a commercial scale.

Strength Tests: Yarn.

MEAN RESULT.

Yarn: Nominal Description.	*44's Twist,* 23·74 *Turns.*	*54's Weft,* 23·74 *Turns.*	*54's Weft,* 22·77 *Turns.*	*50's Weft,* 20·0 *Turns*
Observed Counts	45·7	52·6	53·6	49·8
Observed Twists	25·22	26·59	23·3	21·13
Observed Lea Strength (pounds)	39·5	29·9	29·85	34·88
Lea Strength at Nominal Counts (pounds)	41·0	29·1	29·6	34·8
Ballistic Strength at Nominal Counts	56·4	41·4	40·5	47·5
Single Thread Strength (grams)	156·6	118·2	116·1	125·4
Variability, per cent. ..	11·7	13·0	10·3	9·3
Extension, per cent. ..	5·49	5·20	5·61	5·61

REMARKS.

1. When the 44's Twist and 54's Weft were being spun with American turns, it was observed that the cotton spun very tight, and from this it was judged that it could do with less twisting. It was, therefore, spun to 50's Weft with Egyptian turns, with the result as shown above. This capacity for spinning satisfactorily with less twisting means that to obtain a yarn of given strength a greater production per spindle per hour is possible, with its resultant lowering of production costs. The reason for this is probably due to the fineness of the cotton as compared with Memphis, and on the same account also it is reasonable to expect it to spin to slightly higher counts.

2. The above-mentioned 50's Weft was spun on the same spindles as some combed Uppers Egyptian of the same staple length. The latter gave a single thread of 115·4 grams with an extensibility of 5·46 per cent., so that the Webber, in carded quality, is both stronger and more elastic than Uppers even in combed quality.

3. It is probable that of the three cottons—N.21, S.7, and Webber—this cotton would be classed highest by a broker or spinner relying on the thumb and inspection test only.

4. It is a good lustrous and desirable cotton, and would certainly have a market if it were obtainable in quantity. The yarn showed itself to be very clean and level for a carded quality, although not quite so good in this respect as N.21 and S.7.

VARIETY: NYASALAND UPLAND. (MARK: N. 21.)

Grower's determination of (*a*) Yield, 420 pounds seed cotton per acre; (*b*) ginning outturn, 31·05 per cent.; (*c*) staple length, $1\frac{3}{16}$ inches.

RESULTS OF LABORATORY EXAMINATION AND OF SPINNING TESTS.

MEASURABLE CHARACTERS.

Staple length	29·11 mm. = $1\frac{5}{32}$ inches.
Breaking load	4·44 grams.
Hair-weight per cm.	0·00132 mgm.
Hair width	16·47 μ.
„ „ mercerized	13·34 μ.
Lustre factor	2·49.

Spinning Test: Test applied, No. E.

The scutcher and card losses of this cotton are not available.

Strength Tests : Yarn.

Mean Result.

Yarn : Nominal Description.	*44's Twist,* 23·74 *Turns.*	*54's Weft,* 23·74 *Turns.*	*50's Weft,* 20 *Turns.*
Observed Counts	43·8	51·8	48·3
Observed Twists	26·37	25 59	22·08
Observed Lea Strength (pounds) ..	46·1	30·8	39·3
Lea Strength at Nominal Counts (pounds)	46·0	30·8	38·0
Ballistic Strength at Nominal Counts	54·0	36·5	42·9
Single Thread Strength (grams) ..	176·4	126·4	143·7
Variability, per cent.	9·1	11·5	9·6
Extension, per cent.	4·69	4·81	4·80

Remarks.

1. When the 44's Twist and 54's Weft were being spun with American turns, it was observed that the cotton spun very tight, and from this it was judged that it could do with less twisting. It was, therefore, spun to 50's Weft with Egyptian turns, with the result as shown above. This capacity for spinning satisfactorily with less twisting means that to obtain a yarn of given strength a greater production per spindle per hour is possible, with its resultant lowering of production costs. The reason for this is probably due to the fineness of the cotton as compared with Memphis, and on the same account also it is reasonable to expect it to spin to slightly higher counts.

2. The above-mentioned 50's Weft was spun on the same spindles as some combed Uppers Egyptian of the same staple length. The latter gave a single thread strength of 115·4 grams with an extensibility of 5·46 per cent., so that the N.21, even against combed Uppers, is stronger by about 16 per cent. On the other hand, it is not so elastic.

3. Although the strength test results indicate that this cotton would spin a stronger yarn than the other two in this batch (*i.e.*, S.7 and Webber), it is probable that it would be classed slightly lower than the Webber by a broker or spinner relying on the thumb and inspection test only.

4. It is a good lustrous and desirable cotton, and would certainly have a market if it were obtainable in bulk. The yarn showed itself to be very clean and level for a carded quality.

VARIETY: ALLEN. (MARK: A.2.)

Grower's determination of (*a*) Yield, 464 pounds seed cotton per acre; (*b*) ginning outturn, 29·7 per cent.; (*c*) staple length, $1\frac{5}{16}$ inches.

Results of Laboratory Examination and of Spinning Tests.

Measurable Characters.

Staple length	31·62 mm. = $1\frac{1}{4}$ inches.
Breaking load	4·94 grams.
Hair-weight per cm.	0·00129 mgm.
Hair width	16·09 μ.
,, ,, mercerized	12·51 μ.
Lustre factor	2·63.

Spinning Test: Test applied, No. F.

Total loss up to card sliver = 14·5 per cent.

Owing to the stripping of the card before each sample is put through, the waste loss figures are exaggerated, and do not represent the losses to be expected on a commercial scale.

Strength Tests: Yarn.

MEAN RESULT.

Yarn: Nominal Description.	62's *Twist,* 28·5 *Turns.*	64's *Twist,* 28·66 *Turns.*
Observed Counts	64·5	65·8
Observed Twists	30·82	31·98
Observed Lea Strength (pounds)	31·1	28·8
Lea Strength at Nominal Counts (pounds)	32·4	29·6
Ballistic Strength at Nominal Counts	39·6	36·1
Single Thread Strength (grams)	110·5	113·2
Variability, per cent.	9·6	10·5
Extension, per cent.	4·43	4·22

REMARKS.

1. This is a good, lustrous, and very desirable cotton. The yarn spun from it was strong and regular, and very clean (*i.e.*, free from nep, etc.) for carded qualities.
2. The yarn from this cotton is stronger than the N.17 yarn, but is not so regular or quite so clean. Nevertheless, it is very good for carded qualities.

VARIETY: NYASALAND UPLAND. (MARK: N.17.)

Growers' determination of (*a*) Yield, 675 pounds seed cotton per acre; (*b*) ginning outturn, 31·69 per cent.; (*c*) staple length, $1\frac{5}{16}$ inches.

RESULTS OF LABORATORY EXAMINATION AND OF SPINNING TESTS.

MEASURABLE CHARACTERS.

Staple length	31·14 mm. = $1\frac{7}{32}$ inches.
Breaking load	5·39 grams.
Hair-weight per cm.	0·00158 mgm.
Hair width	16·94 μ.
,, ,, mercerized	14·04 μ.
Lustre factor	2·47.

Spinning Test: Test applied, No. F.

Total loss up to card sliver = 13·1 per cent.

Owing to the stripping of the card before each sample is put through, the waste loss figures are exaggerated, and do not represent the losses to be expected on a commercial scale.

Strength Tests: Yarn.

MEAN RESULT.

Yarn: Nominal Description.	62's *Twist*, 28·5 *Turns*.	64's *Twist*, 28·66 *Turns*.
Observed Counts	66·8	64·5
Observed Twists	30·82	29·82
Observed Lea Strength (pounds)	26·2	31·1
Lea Strength at Nominal Counts (pounds)	27·2	26·9
Ballistic Strength at Nominal Counts	37·9	35·2
Single Thread Strength (grams)	97·3	93·6
Variability, per cent.	10·3	10·4
Extension, per cent.	4·77	4·40

REMARKS.

1. This is a good, lustrous, and very desirable cotton. The yarn spun from it was strong and regular, and very clean (*i.e.*, free from nep, etc.) for carded qualities.

2. This cotton would probably be classed as equal to A.2 by a raw cotton buyer, but from the appearance of the yarn it shows up slightly better, although the strength tests show it to be weaker.

BROKERS' REPORT AND VALUATION OF THE ABOVE FIVE SAMPLES OF COTTON FROM UGANDA.

Description and Mark.	*Value.*	*Classification.*
Sunflower (S.7)	19·50d.	Fairly bright, staple full $1\frac{3}{16}$ inches, a little wasty.
Webber Long Staple Upland (W.)	20.00d.	Clean, bright, good colour, staple $1\frac{1}{4}$ inches.
Nyasaland Upland (N.21)	19.75d.	A little discoloured, staple full $1\frac{3}{16}$ inches, strong.
Allen (A.2)	19.50d.	Dull, fair colour, staple full $1\frac{1}{4}$ inches, but wasty.
Nyasaland Upland (N.17)	18.50d.	Fairly bright, staple $1\frac{1}{8}$ inches to $1\frac{3}{16}$.

Based on August American Futures, 16·00d.

SIERRA LEONE

QUANDE COTTON.

LABORATORY EXAMINATION.

MEASURABLE CHARACTERS.

Stapl length	2·76 cm. = $1\frac{1}{16}$ inches full.
Breaking load	5·31 grams.
Hair-weight per cm.	·00194 mgm.
Hair width	18·52 μ.
,, ,, mercerized	14·69 μ.
Lustre Factor	2·06.

SPINNING TESTS.

Waste loss up to card sliver = 13 per cent.

In bulk the loss should not exceed 11 per cent.

Yarn Strength Tests : Lea Tests.

Count.	*Turns, per Inch.*	*Lea Strength (Mean of 12 Tests).* *Lbs.*
13·48	14	$90\frac{3}{4}$
15·11	14·92	$79\frac{11}{12}$
16·49	15·82	$61\frac{1}{12}$
18·37	16·68	$49\frac{1}{12}$
20	17·49	$41\frac{5}{8}$

The yarns were examined by the Spinning Sub-Committee, and the opinion was expressed that cotton of this character is marketable.

ADDITIONAL SPINNING TESTS ON QUANDE COTTON.

From a bobbin of the Quande roving prepared in the previous Spinning Test respun two cops of yarn; one of 29's Twist and one of 16's Weft, which were compared with two cops of similar yarn spun under the same conditions from American cotton. The results show the Quande yarn to be much stronger and very much more elastic than the American. In appearance, however, it was not so clean and regular. The cotton would be graded equal to Low Middling American.

In another mill a cop of 20's Twist was spun from a bobbin of Quande roving, with the results as shown.

TESTS.

Sample Description.	*Count.*	*Twists per Inch.*	*Single Thread Breaking Load in Grams.*	*Extension, per Cent.*	*Lea Test, Pounds.*	*Ballistic Strength, Inch-Pounds per Lea.*
1. 29's Twist Quande	31·5	19·5 ± 0·4	139·1 ± 1·7	7·3	34·8	70·4
2. 29's Twist American	29·9	19·4 ± 0·4	115·8 ± 1·6	4·9	28·2	48·0
3. 16's Weft American	15·8	13·5 ± 0·2	176·2 ± 3·0	4·8	45·2	65·6
4. 16's Weft Quande	15·4	13·5 ± 0·2	231·3 ± 3·6	6·7	68·8	153·7
5. 20's Twist Quande	19·4	16·1 ± 0·4	309·2 ± 1·1	8·2	59·8	—

Spinners of American cotton would appreciate Quando cotton if it were obtainable in quantity.

BROKERS' REPORT AND VALUATION.

Description.	*Value.*	*Classification.*
Quande Cotton from Sierra Leone. ..	14·15d. (25 points off September)	Creamy in colour, dull. Staple moderately rough. Staple $1\frac{1}{16}$ inches, but irregular.

Based on September American Futures, 14·40d.

PROGRESS OF THE INDIAN COTTON CROP 1915–1925*

BY VARIETIES AND LENGTH OF STAPLE.

Varieties.	*Average during the Three Years* 1915-18 (*in* '000 *Bales*).	*Estimated Crop during* 1924-25 (*in* '000 *Bales*).	*Per Cent. Increase.*
Short Staple (under ⅞ inch):			
Oomras (excluding Hyderabad Gaorani)	1,631	1,970	—
Dholleras	472	606	—
Broach (part)	93	97	—
Bengals	687†	1,042	—
Comillas, Burmahs, etc.	79	112	—
Coconadas	37	54	—
Total short staple	2,999	3,881	29·4
Long Staple (⅞ inch and over):			
Oomras-Hyderabad Gaorani (Bani)	168	450	—
Broach (part)‡ Surat-Navsari, mostly 1,027 A.L.F. (staple 1 inch)	—	122	—
Broach, others	190	114	—
Kumpta-Dharwar‡ Gadag No. 1 (staple 1 inch)	—	15	—
Kumpta-Dharwar‡ Dharwar No. 1 (staple ⅞ inch)	—	20	—
Kumpta-Dharwar, other Kumpta and Dharwar-American	282	308	—
Westerns and Northerns-Sircar No. 14 (staple 15/16 to 1 inch) ..	—	3	—
Westerns, Sircar No. 25 (staple ⅞ inch)	—	6	—
Westerns, other Westerns and Northerns	193	345	—
Tinnevellies including Karunganni-Karunganni (staple ⅞ inch) ..	40	60	—
Tinnevellies, other Tinnevellies ..	66	97	—
Salems and Cambodia—Irrigated Cambodia (staple 1 to 1⅛ inch) ..	101§	139	—
Salems, other Salems and Cambodia	78§	69	—
Punjab and Sind Americans (staple 15/16 to 1⅛ inch)	43	359	—
Total long staple	1,161	2,107	81·5
Grand total	4,160	5,988	43·9

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* This table, which we owe to the courtesy of Mr. B. C. Burt, Secretary Indian Central Cotton Committee, gives an indication of the way in which the cultivation in India of the longer stapled cottons is increasing, as compared with that of the shorter. The percentage increase is much greater.—ED.

† Average for five years ending 1914-15.

‡ Staple greatly improved as a result of the Cotton Transport Act, and now far more uniform.

§ Average for 1916-18. Revised figures reported by D. A. Madras.

REPORTS ON THE RESEARCH WORK CARRIED OUT AT THE COTTON EXPERIMENT STATION, ST. VINCENT, WEST INDIES

BY

L. H. BURD, B.A., Dip.Agr.(Cantab.),
Cotton Research Worker.

I. THE INFLUENCE OF RAINFALL ON THE LINT LENGTH OF SEA ISLAND COTTON IN ST. VINCENT.

VARIATIONS in the maximum lint length of a pure strain of cotton may be ascribed to variations in environment, and those changes which occur from day to day may be regarded as due to changes in the climatic conditions. It has been shown by Balls[1] that the critical period of lint length formation in the life of a boll is about nineteen days after flowering, and also that the maximum length is degraded by water shortage, a rise occurring after irrigation. A similar state of affairs has been shown by Kelsick[2] to exist in St. Kitts, where he found that heavy rainfall during the critical period increased the lint length.

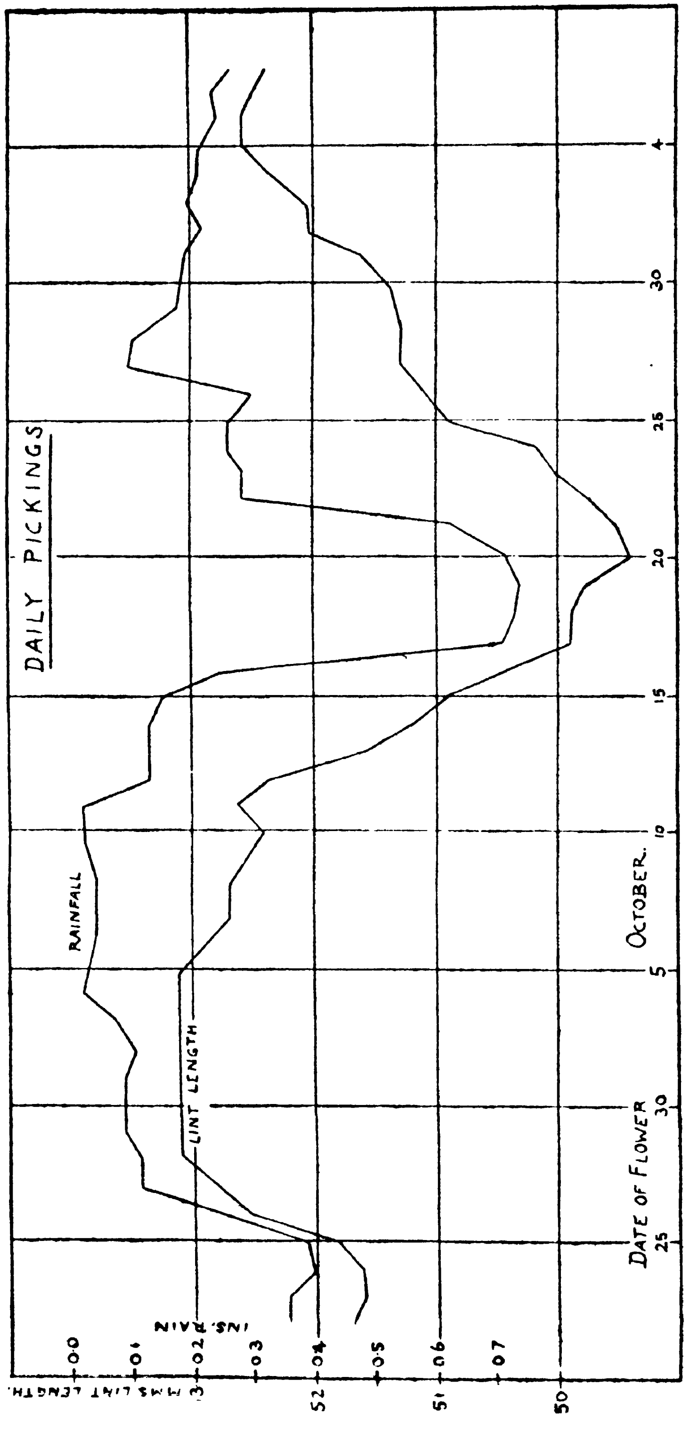
Inasmuch as our water-supply differs markedly from that in St. Kitts and Egypt, it seemed worth while to repeat these investigations, so as to see whether the same relationships prevailed here.

Material and Methods.

About twenty flowers were labelled daily in a plot of pure strain B.F., and the bolls from them picked as they opened, those of which the flowers had opened on the same day being kept together. The mean maximum lint length for any one day was determined by Balls' halo method,[3] eight seeds being used. In this way the probable error of the mean was found to be less than 2 per cent. Rainfall records were made as part of the daily routine of the Experiment Station.

The Data.

In presenting the results, the data for rainfall and mean maximum daily lint length have been smoothed by overlapping five-day means. These figures have then been plotted in such a way that the mean



N.B.—Descent of the rainfall curve means *increase* of rainfall; of the curve of lint-length means *decrease* in length.

maximum lint length for any consecutive five days coincides with the mean daily rainfall during the critical period nineteenth to twenty-first days after flowering.

When this is done, it is obvious that there is a very close relationship between the two curves, and one seems justified in regarding the depreciation in lint length, which is most noticeable in the bolls from flowers which opened on October 20, as being due to the excessive rainfall during the critical period.

A question which is possibly open to doubt is whether the form of the curve for lint length has any real meaning, or whether it is due to chance errors in sampling, measurement, etc. This may be tested as follows.

Consider the two points on the curve at September 30 and October 20. As already mentioned, the P.E. of each original observation is not more than 2 per cent.,* but in the curve these figures have been smoothed by overlapping five-day means, which reduces this P.E. to 0·4 per cent. The actual difference in value between the two points on the curve is 3·7 mm., or about 7·5 per cent. The value of the P.E. of a difference may be taken as $\text{P.E.}_d = \pm \text{P.E.}_m \sqrt{2}$, where P.E._m = the probable error of the mean of one of the results. Here we have $\text{P.E.}_d = 0{\cdot}4\sqrt{2} = \pm 0{\cdot}566$ per cent. The actual difference is 7·5 per cent., or roughly thirteen times its P.E. The odds against such a difference occurring under uniform conditions are many thousands to one,† so that it may be taken that the difference is certainly significant.

If the data are presented as percentage deviations‡ from the mean of the whole series of observations, then the relationships are shown just as clearly. The coefficient of correlation calculated from these deviation data is $\gamma = -0{\cdot}780 - 0{\cdot}0385$.

There is then no reasonable doubt that in St. Vincent the mean maximum lint length of a strain is seriously depreciated by a heavy fall of rain about nineteen days after flowering. The curves seem to indicate that a fall of as little as 0·2 inch may be enough to bring about the change.

Discussion.

These results would seem to be capable of being reconciled with those of Kelsick if the rainfall data for St. Kitts and St. Vincent are compared. The normal annual rainfall for the former is about

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* All the calculations have been made with the aid of a slide rule. Mathematical accuracy in the third significant figure cannot always be expected.

† See the published tables in 3.

‡ The percentage deviations were calculated from those figures which had been smoothed by overlapping five-day means.

45 inches, and for the latter about 100 inches.[4] Thus, it may be that in St. Kitts growth in lint length is normally hampered by incipient water shortage. When heavy rain occurs the short water-supply would no longer be a limiting factor, so that the lint which happens to be at the critical stage in its growth attains a greater length. In St. Vincent, on the other hand, conditions are more humid, and it seems that water is very seldom deficient. Here probably the periodical downpours bring about a water-logged condition around the plant's roots, thus checking the absorption of soil nutrients and so degrading the lint length.

One realizes, however, that it is inadvisable to regard rainfall data as having a direct relationship with the plants; measurements should rather be made of the water-supplying power of the soil and of the evaporating power of the air, as it is obvious that a shower of rain will affect both these variables.

It appears then that the maximum lint length has in this case been changed by the environment through 3·7 mm., which is enough to alter the commercial nature of the crop completely. It might be possible to use the information economically by separating the pickings from the depreciated period. If the cause and the depreciation prove general, it should be possible to predict the depreciation in lint length by about thirty days.

Further, it is obvious that maximum lint length comparisons between different strains are of little value unless the cotton under examination was all produced from flowers which opened at about the same time; comparisons between different years are just as unreliable.

LITERATURE.

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3. Hardy, F.: " The Interpretation of the Results of Agricultural Experiments." *West Indian Bulletin*, Vol. XVIII., April, 1921.
4. West Indian Botanic Station Reports, 1917-21.

Received April 12, 1924.

II. SPACING EXPERIMENT WITH SEA ISLAND COTTON.

Introduction.

Spacing experiments with agricultural crops in general, and with cotton in particular, have been undertaken frequently, and in most cases the probable error of the results has been large, but the work has all suffered from the graver objection that only a few spacings have been tested one against another, and it has been assumed that the best spacing employed in the test was the true optimum of the crop. The dire necessity for testing the crop at only a few different spacings, chosen by the judgment of the worker, and not in a closely graded series, has inevitably arisen from the system under which such experiments have been carried out; obviously any finely graded series, suitably replicated, would require an enormous number of chess-board plots, which would take up an unduly large area, and would be impossible to observe without an unlimited staff. In the experiment to be described it is believed that this difficulty has been overcome, and although this first attempt was more in the nature of a trial of a new method, the results obtained are interesting in many ways. While primarily designed for cotton, there seems to be no reason why the method should not be adopted with other crops.

Plan of Experiment.

Since the method is in some respects novel, we propose to describe it in some detail. Essentially the principle consists in arranging the plants in rows in which the inter-plant distances become smaller and smaller in one direction. When several rows of this kind are placed side by side, the plants may also be looked upon as arranged in columns at right angles to the rows, the distances between the columns obviously varying in exactly the same way as do the plants in each row. Each column then consists of a series of plants at one particular spacing, and by estimating the yield of each column separately and calculating the yield per unit area the figures when plotted should form a tolerably smooth space-yield curve. Reference to the sketch plan in Fig. 1 should make this clearer. Here the plants are shown arranged in rows horizontally, the distances between the plants becoming smaller towards the right. The yield of the columns is then estimated in a vertical direction, and calculated as yield per unit area. Such figures are supposed to have been plotted to form the curve shown, the position of its node indicating the optimum spacing distance. This, of course, would only give us the optimum spacing distance in the row for the particular inter-row adopted; inter-row distance, however, cannot usually be varied beyond comparatively narrow limits because of the necessary cultural operations, so that the theoretical ideal of having the plants equally spaced in all directions is usually impossible of attainment except on a very small scale for experimental purposes. In cotton-growing areas in the West Indies growers seldom make their rows closer than 4 or 5 feet, and it is held that were the distance much less the damage wrought by the weeders and pickers would outweigh any possible increase in the yield; opinions as to the optimum distance in the rows are, however, very unsettled.

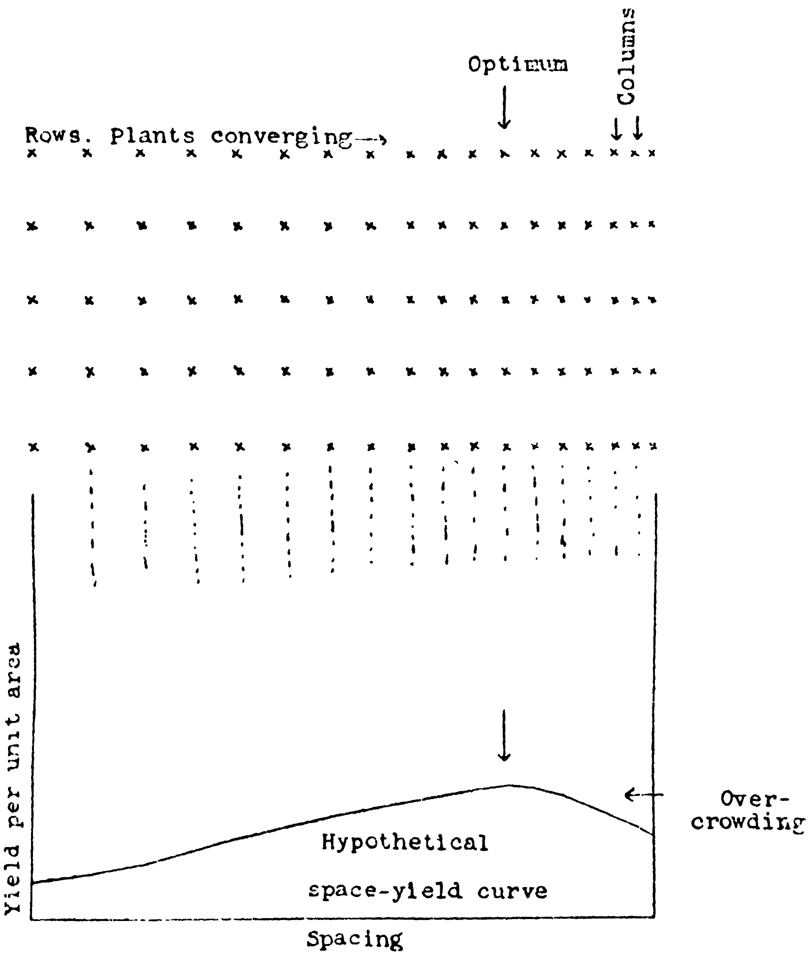

FIG. 1.

In laying out the experiment under discussion the rows were spaced 4 feet apart, the distances between the plants in the row decreasing from 3 feet 3 inches to 5 inches, by a constant decrement of 1 inch, the extent of this range being partly determined by the size of the plots into which the land on which the work was conducted is divided. Four one-tenth-acre plots were used; in two of them, the plants stood singly or one per hole, and in the others two per hole. This gave sixteen rows of thirty-six plants each in one series, and sixteen rows of seventy-two plants in the other.

The material used was the B.F. pure strain of Sea Island.

The Collection of Data.

Our object was to collect data for the columns, as shown vertically in Fig. 1, but since it would be impossible to move about the plots in this direction, especially where the plants were at all close, we took records for each plant separately and totalled the figures later in the manner required. To facilitate this sheets were printed with squares to represent a plot, so that each plant in the plot or each hole had its own particular square. Using these sheets, daily records of the flowering were taken. Bolling records were also taken daily at first, but a full programme of other work and a stringency of labour supply compelled us to extend the time first to alternate days, and later to weekly periods of observation. The sheets were brought into the laboratory as soon as the day's observations were completed, and the figures totalled by columns and the yield computed as flowers or bolls per square yard. These figures were again added at five-day intervals to show the total production to date, and in order to obtain comparatively smooth curves, were smoothed by overlapping five-space means. In this way each point on the curves represents the mean performance of 160 plants. Shedding data would also have been desirable, but apart from the plant diagram system of Harland,[1] which is too cumbersome to be worked on a large scale, we were at a loss for any feasible method. From the design of the experiment any method involving the picking up of fallen bolls would have been useless, as it would have been impossible to tell from which spacings they had fallen.

The Flowering Records—Plots 1 *and* 3, *One Plant per Hole.*—The most striking point is the general form of the curves of output per unit area (Fig. 2). Instead of rising slowly until the maximum is reached at the optimum spacing, and then falling as the density becomes too great, we find that the curves rise with increasing density of plants until a distance of 17 or 18 inches is reached; they then fall off until the point 14 inches, and then finally rise violently as the plants become more and more dense, until we reach the edge of the plots where the inter-plant distance was 5 inches. There is also a slight dip in the curves at spacing 23 inches, and it is interesting that the intensity of the final rise and the dip at 14 inches becomes greater as the plants grow older.

We interpret these phenomena as follows:

From left to right the steady rise of the curve indicates increasing flower production per unit area, due to the greater number of plants on that area. A mode is reached at spacing 18 inches, this being the optimum distance for flower production with the plants one per hole and 4 feet between the rows. The dip at 14 inches is not significant, and is due to some environmental heterogeneity which we have not eliminated by the plot and row scatter, and smoothing the data. The fall of the curve from 18 inches to 14 inches illustrates the overcrowding effect, the decreased yield per plant not being compensated for by the increased number of plants per area. This fall should normally continue to the right, the rise which is actually found being entirely due to the marginal effect. This is rather great, and extends much farther into the plots than we anticipated. It will be considered in detail in Part III.

Flowering Records—Plots 2 *and* 4, *Two Plants per Hole.*—While being broadly similar to the one per hole group, the performance as illustrated by the curves in Fig. 8 is different in certain respects.

Except for the very closest spacings and very latest dates the two per hole groups are always ahead of the one per hole in flower production per unit area, and this superiority decreases as the plants grow older. Considering the latest curve, for November 3, there is at first a slight fall from spacing 39 inches to 30 inches, with a rise at 35 inches; this is followed by, first, a rise to 25 inches, then a slight dip at 22 inches and another rise to 20 inches. From here there is a steady fall until 13 or 14 inches, and again a rapid and violent rise towards the greatest density at the edge of the plots.

The fall at the beginning we attribute to a marginal effect at the wide-spaced end of the plot; and one would expect this to be more marked in the two per hole series. With the wide spacing and one per hole the plants have apparently all the soil they can occupy without utilizing that in the path, but in the two per hole plots, there being twice as many plants on the area, the beneficial effect on the plants towards the outside becomes noticeable. We think that the dip at 22 inches is not significant, and that 19 or 20 inches is the true optimum distance when the plants are left two per hole. This

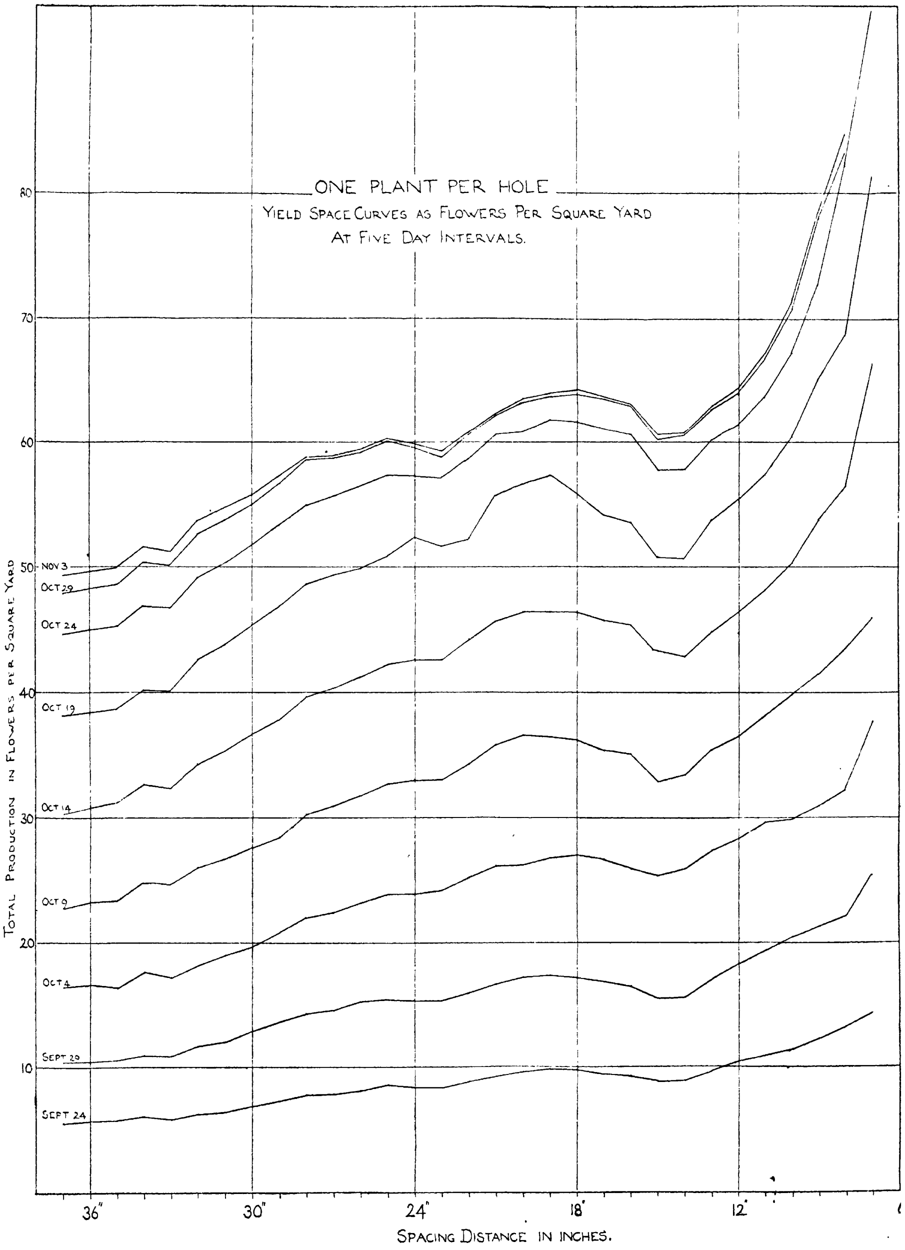
ONE PLANT PER HOLE
YIELD SPACE CURVES AS FLOWERS PER SQUARE YARD
AT FIVE DAY INTERVALS.
TOTAL PRODUCTION IN FLOWERS PER SQUARE YARD
SPACING DISTANCE IN INCHES.
10
20
30
40
50
60
70
80
36"
30"
24"
18"
12"
NOV 3
OCT 29
OCT 24
OCT 19
OCT 14
OCT 9
OCT 4
SEPT 29
SEPT 24

FIG. 2.

[*To face*

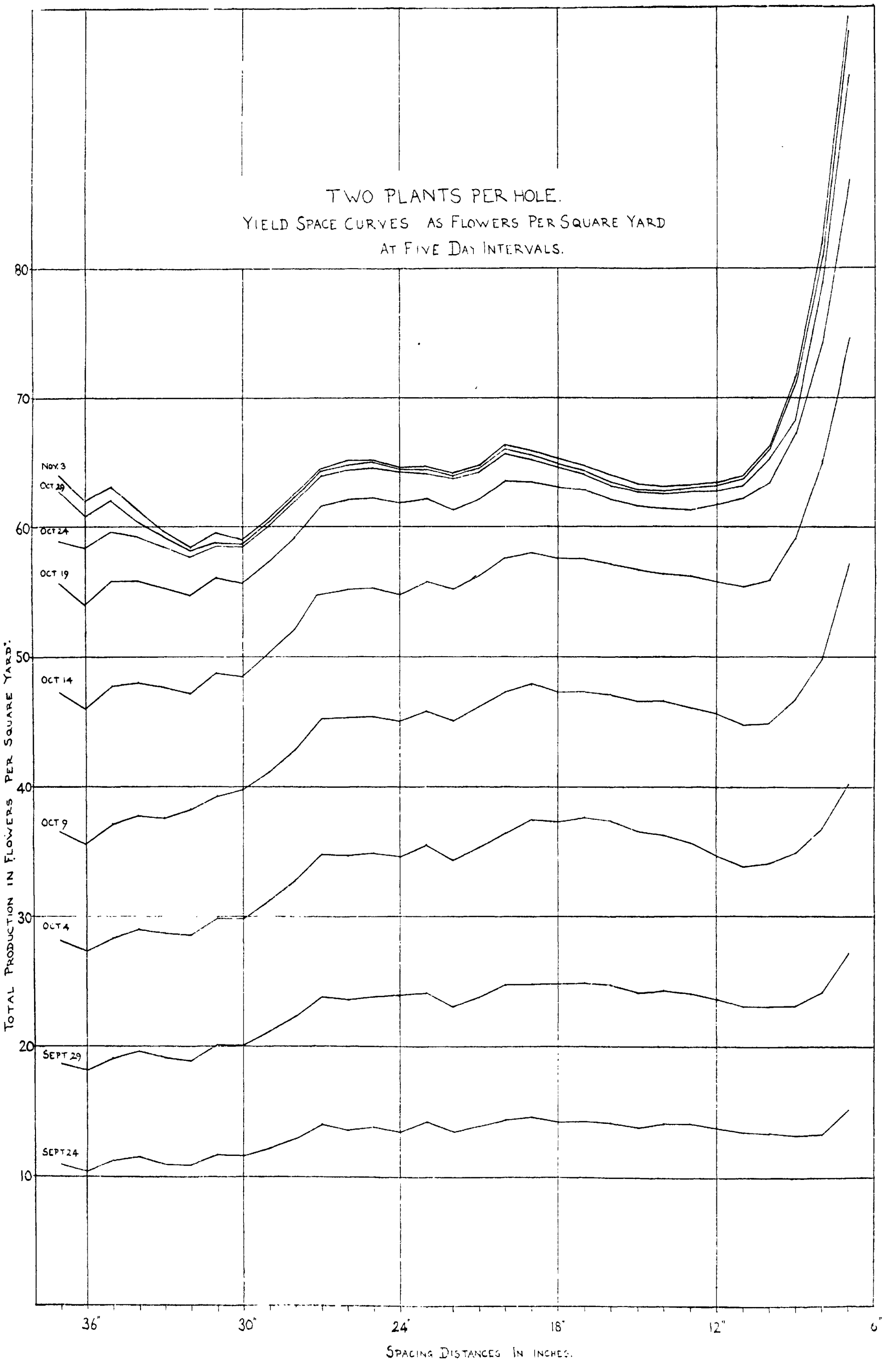
TWO PLANTS PER HOLE.
YIELD SPACE CURVES AS FLOWERS PER SQUARE YARD
AT FIVE DAY INTERVALS.
TOTAL PRODUCTION IN FLOWERS PER SQUARE YARD.
80
70
60
50
40
30
20
10
NOV. 3
OCT 29
OCT 24
OCT 19
OCT 14
OCT 9
OCT 4
SEPT 29
SEPT 24
36"
30"
24"
18"
12"
6"
SPACING DISTANCES IN INCHES.

FIG. 3.

[To fac

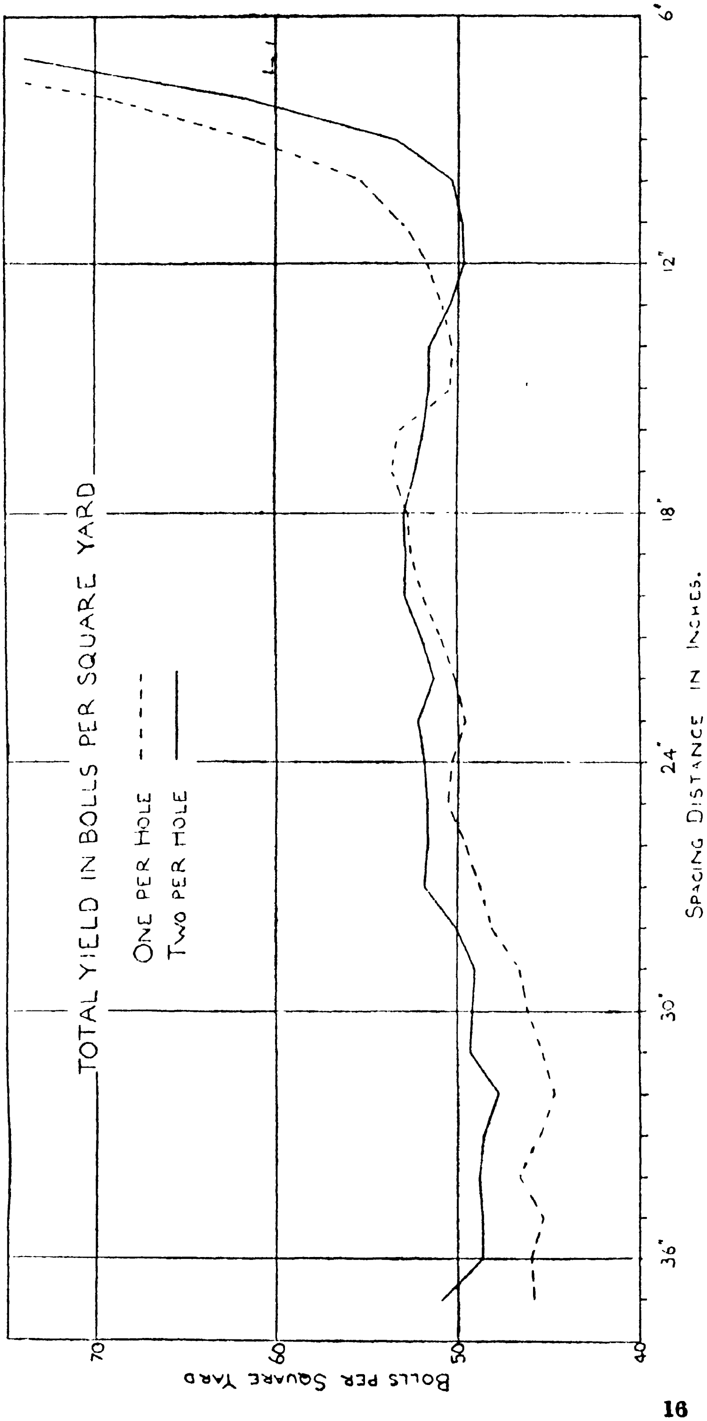
TOTAL YIELD IN BOLLS PER SQUARE YARD
One per Hole
Two per Hole
70
60
50
40
Bolls per Square Yard
6"
12"
18"
24"
30"
36"
Spacing Distance in Inches.

Fig. 4.

optimum corresponds to a total yield of sixty-six flowers per square yard, whereas the optimum for the one plant per hole is estimated as sixty-four flowers. This difference is very small and of doubtful significance. It is interesting to notice that the earlier we make the comparison the greater is the apparent increase to be obtained by leaving the plants two per hole instead of one. The final rise we again attribute to the marginal effect, though its incidence is less marked and does not extend so far into the plot. This is no doubt due to the situation of the plots, and partly to a greater lateral root development in the one per hole series (see Part III.).

The Bolling Records. (Fig. 4).—The curves for the total boll production to various dates resemble closely those for flowering, as would be expected, and the interpretations apply equally to both. In both the one and the two per hole series the optimum density appears to be 1 inch closer than for flowering. What is interesting is that the optimum one per hole yield of 53·3 bolls per square yard beats the optimum for the two per hole by 0·5 bolls per square yard, or 2,420 bolls per acre; hence the conclusion put forward by Balls[2] that leaving two plants per hole "in all circumstances gives about 10 per cent. higher yield" cannot hold for St. Vincent. However, it will be noticed that had our pickings ceased on December 12 instead of being carried on into January, his conclusion would have seemed perfectly true.

General Conclusions.

The true optimum spacing of plants appears to be 17 inches at one plant per hole. With two plants per hole, the optimum distance is a trifle wider, about 19 inches. At 18 inches it appears to be immaterial whether the plants are left one or two per hole.

At all spacings wider than 19 inches the two per hole series will give superior yield, and the wider the spacing the greater the superiority.

There is also a time factor concerned. The earlier one makes the comparison between the one and two per hole series, the greater is the superiority of the latter—*i.e.*, if there is any danger of a loss of bolls at the end of the season, then it would certainly be wisest to leave two plants per hole at 19 inches. The plants should certainly never be closer than 16 inches, as this will involve a decrease in the yield per unit area.

Suggested Adjustments of Method.—It will readily be appreciated that if the densest spacing had been, say, 9 to 10 inches instead of 5, it is extremely likely that the fall in the yield curve due to overcrowding would have been completely masked by the marginal effect, and that the mode corresponding to the optimum density would not have been visible at all.

This difficulty could be overcome by arranging the plants in the rows so that the shortest distance between them is in the middle of the row, the distances growing greater and greater on either side. It would also seem that more than two nominally identical plots are required to obtain smooth curves, and our intention is to repeat the experiment to examine more carefully the form of the curve at its mode, using four plots and the modified form of plant arrangement just suggested.

LITERATURE.

1. HARLAND, S. C.: "Manurial Experiments with Sea Island Cotton in St. Vincent." *West Indian Bulletin*, Vol. XVI., pp. 169-202.
2. BALLS, W. L.: "Analyses of Agricultural Yield," Part I. *Phil. Trans. Roy. Soc.*, B, Vol. 206, pp. 103-180.

Received March 19, 1925.

III. THE MARGINAL EFFECT IN PLOT EXPERIMENTS.

It has long been known that plants growing on the outside of a plot are in a more favourable condition as regards their growth than the remainder, and outside plants are almost invariably excluded from the records of plot experiments. It would seem, however, that little or no attempt has been made, at any rate with cotton, to find out how far these marginal effects may extend into the plots. Any accurate knowledge in this respect is valuable, as its application should tend to reduce the probable error of comparative plot experiments. The records collected during the spacing experiment described in Part II. throw considerable light on the question.

The final rise in the curves for flowering at one plant per hole begins with the plants at 14 inches. If this rise is to be attributed to the marginal effect, it would seem to follow that the roots of these plants must be reaching the path. As their distance from the path was 81 inches, it follows that these plants must have developed lateral roots between 6 feet and 7 feet long.

In the curves for the two plants per hole series, the marginal effect is visible at both ends. Towards the left, at the wide spacing end, the curves for all dates show a dip after the first plant. The first plant is really the third plant in the row in the field, the first two being eliminated in the method of smoothing the data by overlapping five space averages, so that the plant showing the marginal effect is separated from the edge of the plot by two inter-plant optimum corresponds to a total yield of sixty-six flowers per square yard, whereas the optimum for the one plant per hole is estimated as sixty-four flowers. This difference is very small and of doubtful significance. It is interesting to notice that the earlier we make the comparison the greater is the apparent increase to be obtained by leaving the plants two per hole instead of one. The final rise we again attribute to the marginal effect, though its incidence is less marked and does not extend so far into the plot. This is no doubt due to the situation of the plots, and partly to a greater lateral root development in the one per hole series (see Part III.).

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It has long been known that plants growing on the outside of a plot are in a more favourable condition as regards their growth than the remainder, and outside plants are almost invariably excluded from the records of plot experiments. It would seem, however, that little or no attempt has been made, at any rate with cotton, to find out how far these marginal effects may extend into the plots. Any accurate knowledge in this respect is valuable, as its application should tend to reduce the probable error of comparative plot experiments. The records collected during the spacing experiment described in Part II. throw considerable light on the question.

The final rise in the curves for flowering at one plant per hole begins with the plants at 14 inches. If this rise is to be attributed to the marginal effect, it would seem to follow that the roots of these plants must be reaching the path. As their distance from the path was 81 inches, it follows that these plants must have developed lateral roots between 6 feet and 7 feet long.

In the curves for the two plants per hole series, the marginal effect is visible at both ends. Towards the left, at the wide spacing end, the curves for all dates show a dip after the first plant. The first plant is really the third plant in the row in the field, the first two being eliminated in the method of smoothing the data by overlapping five space averages, so that the plant showing the marginal effect is separated from the edge of the plot by two inter-plant distances—namely, 3 feet 2 inches and 3 feet 3 inches, or all together 6 feet 5 inches—which brings us to the same conclusion—*i.e.*, that the lateral roots may be between 6 and 7 feet long.

Towards the dense end of the two per hole plots the marginal effect does not seem so pronounced; those at spacings 12 inches, 5 feet 8 inches from the edge, are the furthest in which it can be detected. Hence, here the length of the roots would seem to be between 5 and 6 feet. This shorter root development is probably due to the greater interplant competition at this density, so that any one individual plant is severely handicapped by the remainder in its growth.

Our conclusion that the lateral roots, at any rate on the one per hole plants, might, and probably did, extend between 6 and 7 feet in a horizontal direction seemed surprising, so we attempted to verify it directly.

A trench was dug alongside the dense end of a row in one of the one per hole plots, and the roots excavated with a water jet. In this way we succeeded in tracing one lateral for a distance of 5 feet 4 inches and another for 4 feet 10 inches horizontally, and even then an unbroken end was not reached, so that a length of 6 feet or even more is certainly a possibility. One interesting feature, though having no particular bearing on the present question, was the discovery of a bed or terrace at a depth of 2 feet 9 inches, which the main tap-roots were unable to penetrate.

It would seem, then, that mere exclusion of outside plants is quite inadequate for the exclusion of marginal errors in plot experiments, and in future for cotton in St. Vincent all plants nearer to the margin than 7 feet should be discarded.

Received March 19, 1925.

THIRD ENTOMOLOGICAL PROGRESS REPORT (AUSTRALIA)

RECEIVED FROM

E. BALLARD

Cotton Entomologist appointed by the Corporation, attached to the Commonwealth Government of Australia.

BRISBANE, *December* 18, 1924.

I AM giving in this report a short account of the insect pest situation on the cotton areas in Queensland, as it exists up to the present time.

With the very favourable season and early rains the plant cotton was sown early, some even at the end of August, and is now forming squares and flowers, and even small bolls.

The ratoon cotton is, of course, much further advanced, and should be ready for a first picking in February.

The Pink Boll Worm (*Platyedra gossypiella*).—In the Central Districts north of the twenty-sixth parallel, which forms the Pink Boll Worm area, most of the standover cotton which had escaped frost, and on which bolls were forming in October, is heavily infested with Pink Boll Worm. In some places the insect has now spread to the ratoon cotton, which is just in the stage to receive it. From all reports and observations, the annual cotton is so far only very lightly attacked if at all. This one would expect, as it is the half and three-quarters grown bolls on which the moths prefer to lay. The close season for cotton was not enforced. The date by which all cotton had to be out of the ground or cut down was extended until December, so that finally no close season existed.

There was evidence that moths were flying from the end of July in the warmer areas near the coast, and in any case the majority of over-wintering larvæ could be expected to produce moths by October or November.

Many farmers refused to pull out their standover cotton, or procrastinated until it was too late for the pulling out to be of any use to form a check to the pest.

There was only one heater available for treating seed, and that was situated at Whinstanes, near Brisbane, and all seed for sowing was passed through this. This involved bringing seed from all areas down the line to Brisbane, with the consequent danger of infection through the trucks, or through seed and seed cotton containing larvæ being dropped on the way. On the score of expense this risk had to be taken as a compromise, though it was not regarded as satisfactory. I should have preferred all seed to be sent to Whinstanes either by sea or in double bags, and gave advice to that effect. The British Australian Cotton Association, however, stated that they were unable to meet the expense involved.

It is to be feared, therefore, that there will be a heavy attack of Pink Boll Worm this year. The method of feeding followed by this insect protects it from the action of parasites, and its control depends on complete cleaning of the fields combined with treatment of the seed. Our efforts are concentrated on keeping the areas which lie south of Maryborough free from infection, and until public opinion is further educated this is all that can be done.

I have advised that two more machines for treating seed should be established, one at Gladstone and one at Rockhampton, and that all seed should be passed through these, whether destined for sowing or for the Oil Mill at Brisbane.

An insect which was at first thought to be the *Peach Moth* (*Dichocrocis punctiferalis*) is spread throughout the cotton areas, and last year did a great deal of damage. It has now been ascertained that the damage was ascribed incorrectly to the Peach Moth, though the caterpillar and the method of attack are very similar. The insect is not yet identified. Experiments in control and study of its life history are now being conducted. There was a brood early in October which attacked the terminals of the cotton.

At Gatton Agricultural College, where there are some experimental cotton plots, the ratoon cotton was attacked first, the larvæ eating the terminals first, and later, early in November, leaving these for the squares. This insect when feeding, especially before any bolls are formed, is exposed to attack, and in actual fact the generation produced in October was very heavily parasitized, so that individuals are now difficult to find.

Observations and reports show that, taking the cotton areas as a whole, the attack is only just developing now, and it is hoped that parasites (the one bred is a Braconid wasp) will keep it in check. A bad attack might be expected in late January or early February.

Maize Grub (*Chloridea obsoleta*).—There was an early generation of this pest in September, the eggs of which were heavily parasitized. Survivors produced a second and a third generation of moths. The last is now laying, or has laid. In some districts it is on the cotton as a light attack, and individuals can be found here and there, but where there is any maize in the vicinity of the cotton, the moths have concentrated on that, and the cotton has so far escaped. Everything at present indicates that careful cultivation combined with trap crops intelligently used will form the solution of the problem of control of this insect. Dusting is, however, being experimented with in case, in a dry year, it should be impossible to plant maize in time. The dry season last year was almost certainly responsible for the damage done to the cotton crop, as maize could not be planted early, and when mature the silk shrivelled and dried up, so that the moths were driven to the cotton.

This season there is an abundance of food, and tomatoes, wild Cape gooseberry and maize all show maize grub attack, while the cotton is free, except for rare specimens.

Harlequin or Chinese Bug (*Tectacoris banksii*).—This insect is being studied from several points of view, firstly to ascertain to what extent it is responsible for the transmission of internal boll rots; secondly, in methods of control; and, lastly, its life history. This latter, it appears, is lengthy. The over-wintering adults which escaped the frost appeared on the cotton by October and November, and in the more northerly districts were ovipositing early in October on standover cotton and wild hibiscus. The population in the fields is still very small, and eggs are heavily parasitized, some egg masses up to nearly 100 per cent.; others appear to have escape fairly lightly.

Dysdercus sidæ and Homæocerus sp.—These two insects are treated together, as their method of attack—sucking squares and bolls—is similar. Dysdercus is present on malvaceous plants and in standover cotton, but has hardly appeared on plant cotton yet. Homæocerus was causing square shedding in the Boyne Valley on my experimental plot there, at first up to 12 per cent., later this fell to 2 to 4 per cent. Eggs collected show that a large proportion are parasitized.

Aphis gossypii Glover.—This began early in October, but parasites and predators were numerous and soon had the situation in hand.

The Rough Boll Worm (*Earias huegeli*) is doing some damage to terminals and squares, but is not yet regarded as being in serious pest condition.

There was some damage done to terminals of ratoon cotton, by *Eucosma plebiana* Zeller, the caterpillar of a small moth. This attack now appears to have ceased, as caterpillars and moths are scarce.

Grasshoppers of various species and caterpillar of *Cosmophila* (?) *erosa* are at work on the leaves, but doing no damage, as cotton can easily stand the loss of some of its foliage.

On the whole the situation is hopeful. Parasites and predators are very abundant, and the plant cotton is in good condition.

Danger may be anticipated from the standover and abandoned ratoon cotton, so far as the Pink Boll Worm is concerned. It is possible that the mild winter cut short the hibernation period of some of the other chief pests, and these emerging, finding ratoon cotton well advanced and plenty of food, have increased to such an extent that they have provided hosts for parasites, so that succeeding broods will be more heavily parasitized than would otherwise have been the case.

THE BEST FIELD METHOD FOR SOWING COTTON

BY

W. LAWRENCE BALLS, M.A., ScD., F.R.S.

THE note by Mr. Sawhney* in the January issue of this review has reminded me of my own experiences in collaboration with Mr. F. S. Holton in 1912-13, when we broke some records for rate of seed propagation. No detailed account of our technique has been published, but it may be summarized thus: We produced as many seeds as we could from each plant (by wide spacing), and then raised as many single plants as we could from the available seed, by " sand sowing."

The present note deals with this Sand-Sowing technique, the effects of spacing having been fully described by us previously, though from a different angle.† The actual practical result of this dual method should first be noted, however; it was this, that in three separate cases we produced a *ton* of ginned seed in the 1913 harvest grown from the offspring of *one seed* sown in 1911. Moreover, this was done under most difficult conditions of extemporization, so that a great increase in these figures is easily practicable.‡ If " practical men " would realize the possibilities that await the adventurer who, for a special purpose, will break away from practice, our control of seed supplies might be very much improved, and the plant breeder's skill would be more effectually utilized.

Mr. Sawhney has the credit of being the first to call attention to the advantages of plain sand as a seed bed for cotton, but his method does not go so far as it can be pushed. As described by him it is a " garden " technique, the seedlings being washed out and transplanted. But it is easier, quicker, cheaper, and safer to make the sand seed bed out in the field where the adult plant is to stand, and still obtain such remarkable efficiency as was shown by our statistics—viz., 70 to 90 per cent. of adult successes on a twenty-acre field when only single seeds were sown.

In my earlier cotton breeding researches I had tried various approved methods for economizing seed, to mitigate the feeblemindedness of the infant cotton plant. The farmer's method of sowing eight to twenty seeds per hole and thinning to two seedlings is useless when seed economy is all-important. As it is imperative to provide some kind of soil-breaker, I tried—and rejected—an American dodge of using beans; they merely burrow out, without lifting the clods of soil. Then a better plant was tried—viz., Bamia (or Okra, *Hibiscus esculentus*)—and in special cases cotton itself, utilizing the Red-leaf Uplands. With Bamia or Red-leaf it was possible to sow single pedigree seeds, but the thinning process was tedious. Too much risk was run by the single pedigree seedling if its neighbours were roughly uprooted, and it was also liable to be " drawn " if thinning were at all delayed; cutting out with scissors was eventually practised, but besides being slow and tiring, it left rotting roots in the ground.

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* Sawhney, K., *Empire Cotton Growing Review*, Vol. II., 1925, p. 42.

† Balls, W. L., and Holton, F. S., *Phil. Trans. Roy. Soc.*, B, Vol. 206, pp. 103, 180.

‡ See Report of Imperial Botanical Conference, 1924, p. 84.

Finally, stimulated by emergency in the shape of a plague of mole-crickets (which left us with only 2 lbs. of seed and fifteen wide-sown acres to replant), we devised the sand-sowing method. We afterwards learned that it is current practice with the native cultivators in Tokar, though in a cruder form. It was subsequently adopted by Mr. H. C. Jefferys for propagation work on the State Domains, with a seed-rate of, I believe, three seeds per hole. My present purpose is to describe our technique as used, successfully, for the ideal seed-rate of one seed per hole; and in particular I wish to emphasize the point that this limit of refinement can be reached with very little trouble and at a trifling cost.

Equipment.—1. Cotton seed, preferably soaked and just starting to crack.

2. Any receptacle with a sling handle, holding a pint or so of fine sand, sifted through a 144-mesh or finer.

3. A large teaspoon, or similar ladle, for handling the sand.

2 *and* 3. *Alternatively*, an arrangement like the old muzzle-loader powder flask would be excellent, delivering a small fixed quantity of sand.

4. A round wooden dibble, the size of a pencil—*i.e.*, just thick enough to make a hole into which one seed will drop freely. A wire nail driven through it sideways, at 1 inch from the end, defines the depth of the hole it makes.

5. A hoe.

6. On special occasions only, a fountain-pen pipette in a receptacle like (2), but holding water.

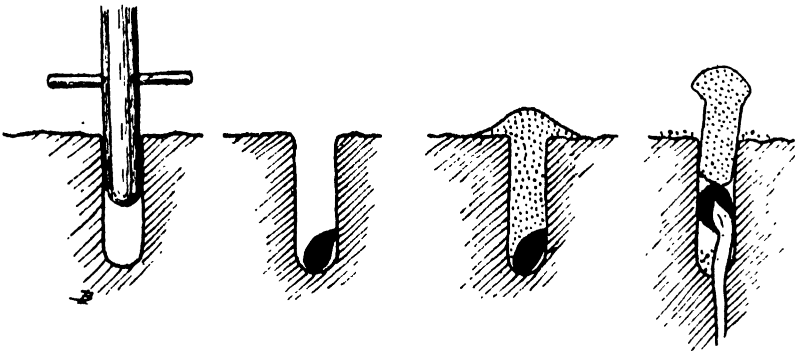
Method.—Sowing is best done in wet soil, which will not need further irrigation or rain. For ordinary sowing in Egypt the work is done by pairs, a man opening the holes with a hoe, and a child following to drop and cover the seed. The present method is carried out most quickly by gangs of three, thus:

The leader, who carries the hoe, pulverizes and consolidates for a hand's-breadth the soil where each plant is to stand, in order to increase the subsequent upflow of soil water and make a good seed bed.

The second of the gang, carrying dibble and seed, dibbles the 1 by ¼ inch hole in this prepared soil, drops one seed to the bottom of the hole, and cleans the dibble.

The third ladles a spoonful of sand into the hole, having previously squirted a pipette of water upon the seed if the soil is on the dry side.

When first we tried this method we found the subsequent procedure of the cotton plant rather unexpected. The seedling rarely breaks the plug of sand, which is usually simply lifted like a cork coming out. Finally, the plug falls over and breaks, and the seed leaves unfold through its débris. The diagrams are self-explanatory.



Sowing single seeds.

Details.—Size of dibble will, of course, vary with the size of the seed, and ranges from ⅛ by ½ inch with some Indian cottons to ½ by 1½ inches with some fuzzy Uplands. The fit should always be as close as is practicable. A pint or so of sand, or of water, will evidently be sufficient for 200 to 800 holes, so that replenishments do not call for elaborate transport arrangements. Dibbles can be made by the score in an hour, and old jam-pots with a loop of string are not expensive. Under labour costs we have to reckon for one extra child, plus the fact that the gang of three will be well advised to progress rather more slowly than the usual gang of two; for the operation, though simple, is worth a little extra care. To credit we may set the value of some seed economized—*i.e.*, 90 per cent. of the usual cost of seed.

* * * * *

However, my purpose is not to advocate the everyday use of this method, for seed is cheap; though where maximum acreage is desired from a limited stock of seed the method can be worked commercially. My wish is to show that the sand-sowing method can be taken out into the field, carried to any degree of refinement up to the limit of one seed per hole, and used as easily and successfully on hundreds of acres as on a small plot. Lastly, if it may seem a small thing to raise ten separate plants instead of two half-plants from twelve seeds, the reader has probably forgotten that each year multiplies the effect, so that after two years the difference is not 10:1 but 100:1, and has become a million to one after only six years. Since this is only half the control we can exert on seed propagation (spacing giving the other half), there is no reason why we should go slowly, following in the footsteps of the farmer who must set his pace entirely by considerations of profit and loss.

Received March 26, 1925.

ASSISTING GERMINATION OF COTTON SEED

THE following letter has recently been received by the Editor:

SIR,

With reference to Mr. R. C. Wood's report on work in Tanganyika Territory and Mr. Sawhney's note on a method of transplanting cotton seedlings, the following notes on a method we adopted in Egypt for assisting germination of valuable seed may be of interest.

In Egypt seed is usually sown dry and irrigated immediately afterwards. The seed takes about eleven days to germinate, and during this time a hard crust is formed, due to the very rapid drying at the surface of the soil. The ordinary method of field crop sowing is to sow anything from twenty to fifty seeds in one hole. The combined efforts of these seeds will lift large lumps of soil if necessary, but there is a great waste of seed.

At first we sowed ten or twenty bamia or okra seeds (*Hibiscus esculentus*) in the same hole as the cotton, which required assistance. The bamia, however, germinated more rapidly than the cotton and did not seem to be very satisfactory.

We tried to obtain a quantity of pure Red Leaf seed from America, but failed. So we multiplied up to a considerable bulk a few plants of pure Red Leaf (probably the Willett's Red Leaf left by Dr. Balls) which we had been keeping on. We now have an area of this cotton which is quite pure, and which is ratooned.

Red Leaf seed sown with green leaf seed assists germination excellently and can be readily distinguished, even in the cotyledon stage, from the green leaf cotton.

Being a fully fuzz seed, it germinates rather more slowly than the less fuzzy or almost naked Egyptian seed, so we soaked the Red Leaf seed before sowing for a day. This would be unnecessary when sown with fully fuzz types of seed, such as the ordinary American seed.

The method requires care in roguing out the Red Leaf to ensure complete elimination. The possibility of delayed germination must not be forgotten, so more than one roguing should be given. Even if a plant were left by accident, however, the Red Leaf hybrid is readily distinguished from the green leaf cotton.

For propagation of the Red Leaf from year to year, it should also be noted that the seed from the pure Red Leaf stock may actually contain hybrid seeds due to crossing with green leaf cottons, so that the propagation plot of Red Leaf also requires most careful roguing. The hybrid is, however, equally readily distinguishable from the Red Leaf, and if ratooning is possible, once the pure Red Leaf is established, no further roguing is required.

The essential is that the seed used to assist germination should come from genetically pure Red Leaf plants, so that the resulting plants can never be more than an F 1, and so are readily distinguished, even by unskilled labour, from green leaf plants.

I have no doubt that the Botanical Section, Ministry of Agriculture, Giza, Egypt, would be glad to supply small quantities of Red Leaf seed to other workers on application being made to them.

Yours truly,
TREVOR TROUGHT.

P.S.—The method of delinting fully fuzz seed with H_2SO_4, which is used in Australia and stated to accelerate germination by about one day, is being tried this year with the Red Leaf.

COTTON GROWING STATISTICS—VI.

BY

JOHN A. TODD.

CONSUMPTION.

In the five previous issues we have dealt more or less briefly with the whole of the world's cotton crops, and before settling down in future issues to a regular periodical revision of the position of these crops, it is desirable to complete our survey by describing the statistical information available with regard to consumption. Until about the beginning of this century practically the only information available which bore even indirectly on the question of consumption was the statistics published by the various cotton exchanges of spinners' takings or cotton forwarded to spinners. In 1903, however, the International Cotton Federation was formed, and one of their first objects was to evolve an international system for the periodical collection of statistics of consumption and stocks. It took some time, of course, for this system to become even approximately complete, but from 1905 annual statistics of consumption were published after the end of each season, and half-yearly statistics of stocks.* The war, of course, stopped the compilation of these statistics, but they were resumed at the end of season 1919–20, and in 1921 the consumption statistics were also made half-yearly. At first the statistics published by the Federation were simply a summary of the actual returns received by them, and the number of spindles making returns was also stated for each country, along with an estimate of the total number of spindles in the country. From these data it became possible to calculate the probable total consumption of each country, on the assumption that the spindles not making returns were consuming cotton at the same rate, and in the same proportion for the different varieties, as those which did make returns; and this calculation was made by the writer from 1906-07 onwards. Since July, 1923, the Federation have themselves adopted this method, so that the figures published by them now represent the total consumption; and, as in most countries the percentage not reporting is comparatively small, the probable error in the calculated total is not likely to be serious, especially in comparative statistics over a period of years.

In 1905 the Census Bureau of the United States Department of Commerce began to publish annual returns of consumption in the U.S., based on actual returns from every cotton mill, and these have been published monthly since September, 1912. The value of these statistics lies, of course, in their more frequent publication, and as, since the war, America's share of the world's consumption, especially of American cotton, has risen far above its pre-war proportion, the monthly Census Bureau figures have acquired a value which is seldom realized in this country.

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* Stocks will be dealt with in the next issue.

In the Statistical Appendix to the "World's Cotton Crops," the writer gave the statistics of the world's spindles and consumption, calculated from the Federation returns as above described from 1906 to 1913, with details of consumption by countries *and varieties* for the last pre-war season, 1912–13. It would take a great deal more space than is available here to bring these statistics down to date in full, but the following table summarizes the results for the chief groups of countries and for the different varieties since the resumption of the statistics after the war, with the last pre-war season for comparison. Table II. gives a summary of the U.S. monthly consumption according to the Census Bureau figures for every season since 1912–13, with the monthly figures since August, 1922.

Lack of space again prevents any adequate comment on the statistics, but perhaps the most interesting line of comparison that may be suggested for readers to follow out themselves, is the comparative consumption in each group of countries, post-war against pre-war. Roughly speaking, in the case of American, the United Kingdom and the Continent are still far short of their pre-war consumption, while the U.S.A., Asia, and others have greatly exceeded their pre-war figures. With regard to Indian cotton the United Kingdom and the Continent have also improved on pre-war figures. In the case of Egyptian, the United Kingdom has substantially exceeded pre-war figures, while all other countries show no very great change. In the case of the United States there was, as is more fully brought out in Table II., a very remarkable increase of the consumption of Egyptian in 1915–1917 and again in 1919–20, this being mainly due to the enormous consumption of Egyptian cotton in tyre fabric.

The statistics of consumption of sundries must be taken with a great deal of reserve, in the first place because they are peculiarly incomplete owing to the war and post-war disturbances—*e.g.*, in Russia—and also because of the wide fluctuations in the bale weight, especially in such countries as Brazil, Russia, etc. Further, in these countries the position is complicated by purely domestic consumption—*i.e.*, entirely outside of mills, of which the statistics are sometimes purely conventional, as in the case of India, or entirely unknown, as in China.

TABLE I.—WORLD'S CONSUMPTION OF ALL KINDS OF COTTON.

(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)

(000s OF RUNNING BALES.)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*All Others.*	*Totals.*
American (including linters in U.S.A.) ..	1912-13	3,667	4,593	5,553	519*	124	14,456
	1919-20	2,980	2,538†	6,345	709	209	12,781
	1920-21	1,678	2,802	5,193	684	192	10,549
	1921-22	2,275	3,593	6,252	1,031	216	13,367
	1922-23	1,919	3,293	6,960	859	201	13,232
	1923-24	1,695	3,199	5,892	661	172	11,619
	1924-25 (first half)	1,092	1,869	3,108	333	103	6,505
Indian	1912-13	53	813	—	3,073*	2	3,941
	1919-20	58	444†	12	3,196	—	3,710
	1920-21	39	770	10	3,749	2	4,570
	1921-22	55	824	11	4,032	—	4,922
	1922-23	107	977	21	4,276	1	5,382
	1923-24	201	1,247	27	3,922	7	5,404
	1924-25 (first half)	86	555	16	2,047	28	2,732
Egyptian ..	1912-13	393	380	134	17*	12	936
	1919-20	441	173†	216	24	—	854
	1920-21	237	136	106	22	13	514
	1921-22	336	208	151	38	9	742
	1922-23	393	272	174	40	10	889
	1923-24	469	354	149	39	16	1,027
	1924-25 (first half)	233	181	56	26	4	500
Sundries ..	1912-13	161	2,128	32	156*	818	3,295
	1919-20	141	116†	160	1,077	614	2,108
	1920-21	70	1,039	67	981	672	2,829
	1921-22	199	716	114	980	708	2,717
	1922-23	351	616	98	1,262	850	3,177
	1923-24	353	529	76	1,351	576	2,885
	1924-25 (first half)	152	373	36	748	420	1,729
All Kinds ..	1912-13	4,274	7,914	5,719	3,765*	956	22,628
	1919-20	3,620	3,271†	6,733	5,006	823	19,453
	1920-21	2,024	4,747	5,376	5,436	879	18,462
	1921-22	2,865	5,341	6,528	6,081	933	21,748
	1922-23	2,770	5,158	7,253	6,437	1,062	22,680
	1923-24	2,718	5,329	6,144	5,973	771	20,935
	1924-25 (first half)	1,563	2,978	3,216	3,154	555	11,466

* China included in others in 1912-13.

† No returns from Russia and Austria in 1919-20.

TABLE II.—U.S. CONSUMPTION OF COTTON BY VARIETIES.

(000s of Running Bales: Foreign in Equivalent 500-lb. Bales.)

		Total.	*Upland.*	*Egyptian.*	*Other Foreign.*	*Sea Island.*	*American Egyptian.*	*Linters not Included.*
Monthly Averages.	1912–13	456·9	433·0	16·8	2·6	4·7	—	25·3
	1913–14	464·8	441·8	12·6	3·6	6·8	—	25·6
	1914–15	466·4	441·3	15·1	3·4	6·6	—	34·3
	1915–16	533·1	499·8	22·4	4·0	6·9	—	73·4
	1916–17	565·7	531·3	21·6	4·9	7·9	—	72·5
	1917–18	547·2	524·7	11·4	3·9	7·2	—	93·2
	1918–19	480·5	461·6	10·5	4·2	4·3	—	38·2
	1919–20	535·0	492·8	26·9	7·8	3·6	3·8	28·5
	1920–21	407·7	386·8	13·3	4·7	1·6	1·4	43·0
	1921–22	492·5	462·9	18·9	5·9	0·7	4·1	53·3
	1922–23	555·5	520·9	21·9	6·8	0·5	5·4	53·8
	1923–24	474·0	443·3	18·7	8·7	0·4	3·0	44·3
	1924-25 (9 months)	518·8	493·9	15·4	7·2	0·3	1·7	51.9
Monthly Figures, 1922–23.	August ..	526·4	495·6	16·7	5·4	0·7	7·9	62·8
	September	494·0	467·3	13·2	5·0	0·7	7·8	61·5
	October	533·7	504·4	15·5	5·5	0·9	7·6	62·6
	November	579·2	544·5	20·4	6·9	0·6	6·7	55·1
	December	529·3	495·9	21·3	5·9	0·5	5·7	49·1
	January	610·3	571·8	25·9	6·9	0·6	5·0	50·5
	February	566·8	528·9	25·9	7·0	0·5	4·5	47·3
	March ..	624·3	584·2	27·4	7·6	0·4	4·6	54·5
	April ..	576·5	538·0	27·1	7·2	0·3	3·9	52·6
	May ..	620·9	578·0	29·2	8·8	0·4	4·6	55·1
	June ..	542·0	508·6	22·5	6·7	0·4	3·8	48·9
	July ..	462·7	433·7	17·1	8·4	0·4	3·1	45·9
*Monthly Figures, 1923–24.**	August ..	491·6	464·9	17·3	6·5	0·4	2·5	48·0
	September	483·9	458·8	15·2	7·1	0·3	2·5	49·6
	October	541·8	510·0	20·2	7·6	0·4	3·6	57·1
	November	531·6	502·3	19·2	7·1	0·5	2·5	48·1
	December	461·6	434·0	17·5	7·3	0·5	2·2	40·9
	January	576·6	542·6	22·7	7·8	0·5	3·0	40·3
	February	507·9	475·2	22·4	7·3	0·5	2·5	41·7
	March ..	483·9	450·9	20·4	9·2	0·4	3·0	41·0
	April ..	480·0	445·9	20·5	8·7	0·6	4·3	42·3
	May ..	413·6	384·6	15·8	9·4	0·3	3·5	42·5
	June ..	350·3	326·1	13·9	7·1	0·2	3·0	39·6
	July ..	346·7	322·4	12·9	7·3	0·3	3·9	40·9
*Monthly Figures, 1924–25.**	August ..	357·5	336·2	11·3	6·8	0·4	2·9	44·3
	September	435·2	410·8	13·5	8·2	0·5	2·3	50·0
	October	532·6	506·9	14·0	9·1	0·4	2·3	55·1
	November	492·2	473·3	10·1	7·2	0·2	1·4	51·0
	December	532·0	507·4	16·5	6·5	0·3	1·3	46·2
	January	589·7	561·5	18·7	7·0	0·4	2·2	51·8
	February	550·1	523·0	17·7	6·8	0·3	2·3	50·6
	March ..	582·7	556·2	18·0	6·8	0·3	1·5	58·8
	April ..	597·1	570·0	18·5	6·9	0·3	1·3	59·0
	May ..	—	—	—	—	—	—	—
	June ..	—	—	—	—	—	—	—
	July ..	—	—	—	—	—	—	—

* Subject to revision.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

285. We have received the following Report:
"Scientific Reports of the Agricultural Research Institute, Pusa," 1923-24.

286. Cotton Cultivation in Sind. By E. G. Sabine. (*Int. Cott. Bull.*, 1924, **3**, 216. Abstr. from *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 17.) The constructional and financial aspects of the Lloyd Barrage and Canals project, better known as the Sukkur barrage and canals project, are given in some detail. Ten canals equalling 805 miles in length will serve a distribution system 3,724 miles long, commanding a total area of 8 million acres. Of these 5½ million acres are expected to be cultivated at the end of thirty years. In the tract affected by the barrage 236,000 acres are annually put under cotton, and the new scheme is designed for ¾ million acres; but it is the opinion of many authorities that as great an area as 2 million acres may be predicted. As designed, however, an eventual yield of 600,000 bales is anticipated—*i.e.*, at nearly ⅝ bale per acre.

287. Indian Cotton: Morphological Factors Influencing Yield. By S. C. Harland, D.Sc. (*Trop. Agriculture*, vol. ii., No. 2, 1925, p. 29.)

288. Technological Research Laboratory of the Indian Central Cotton Committee. (Abstr. from the *Agr. Journ. of India*, vol. xx., 2, 1924, p. 81.) In December last the Viceroy of India opened the Spinning Laboratory and laid the foundation stone of the Research Laboratory of the Technological Research Institution.

In his speech at the opening ceremony Dr. Clouston, the President of the Indian Central Cotton Committee, after tracing the chain of circumstances which led to the formation of the Committee, gave an interesting account of the work accomplished since its inception. He stated that the work of the two new laboratories would be to carry out practical spinning tests on small samples of new types of cotton produced, and to conduct a thorough chemical, microscopical and physical examination of each cotton sent for trial. By collating the results obtained from both laboratories it is hoped to achieve a better understanding of cotton as a raw material, and of how it is likely to behave when spun.

Lord Reading, in his reply, spoke of the great value of the work, and said that its effect in assisting in the selection of the most suitable varieties of cotton for growing, and in placing facts before producers and consumers of first importance in the marketing of cotton could not be over-estimated.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

289. The following Reports have recently been received:

Fiji	Annual Report of Department of Agriculture for 1923.
Nigeria	Third Annual Bulletin of the Department of Agriculture, July 1, 1924.
Nyasaland	Annual Report of Department of Agriculture for 1923.
Queensland	Annual Report of Department of Agriculture and Stock, 1923-24.

St. Vincent	Annual Report of Department of Agriculture, 1923.
Sudan	Report of Government Chemist for 1924.
Imperial College of Science and Technology, South Kensington.	The Seventeenth Annual Report for the year ending July 31, 1924.

290. COTTON GROWING IN THE BRITISH EMPIRE AND EXOTIC COUNTRIES. By Captain G. S. Burnham. (Sherratt and Hughes, 34, Cross Street, Manchester, price 2s.)

291. ASIA: CYPRUS. We learn from the *Cyprus Agr. Journ.*, vol. xx., pt. 1, that cotton in Cyprus is very heavily attacked by insects, particularly by two, *Gelechia gossypiella*, the Pink Boll Worm, and *Earias insulana*, the Spiny or Common Boll Worm. Apart from biological measures of control which are being instituted, it is proposed in the very near future to establish experimental plots to determine the type of cotton most suitable for the Island. The Abbot of Kykko has kindly set apart an area for these experiments at the Monastery near Nicosia.

292. *Cotton Cultivation in Cyprus.* By J. Dawson Shepherd. (*Cyprus Agr. Journ.* vol. xx., pt. 1, 1925, p. 15.) In this article " wet " and " dry " methods of cotton cultivation are discussed. The writer sounds a note of warning to the Cypriot cotton farmer with regard to the serious damage the Pink Boll Worm—which is present in large numbers in the island—may cause to his cotton crop, and urges the necessity of co-operation between the grower and the Agricultural Department with a view to the organization of a campaign against the pest.

293. IRAQ COTTON GROWING. (*Finan. Times, March* 4, 1925.) The negotiations between the Iraq Government and the Norton-Griffiths Syndicate, with reference to the irrigation works to be carried out in Iraq in connection with cotton growing, have now been completed. Under the contract the Syndicate agrees to construct: (*a*) At Felujah, on the Euphrates river, a barrage and reservoir and the irrigation systems dependent upon these works; (*b*) A weir on the Diyalah river and the system of irrigation works dependent on it; and (*c*) a dam at Tawilah on the Diyalah river, to form a reservoir approximately covering the whole of the Diyalah reservoir area of some 400 square miles, with water sufficient for the cultivation of some 7,000,000 acres of cotton annually. The total cost of these works will, it is estimated, be £17,000,000.

294. AFRICA: *The African Cotton Journal,* vol. i., No. 1, Johannesburg, February 18, 1925. Yet another newcomer to the field of cotton journalism in Africa has to be welcomed. The growth in the number of such journals in Africa is evidence of the increasing interest being taken in cotton there, and we may hope that in time Africa will become one of the great sources of the world's supply.

295. EAST AFRICA. *Report of the East Africa Commission.* London, April, 1925. This most important and valuable report has just appeared. Keeping clear of those topics upon which there is sure to be much controversy, it may be noted that the great recommendation is that capital be provided on loan by the Imperial Government for the opening up of the country by rail, road and water—the most urgent desideratum at the present stage, and a thing which the local Governments cannot do for want of funds. This provision of capital on loan has, of course, already begun in the case of the extension of the Uganda Railway.

Land settlement on terms fair to all parties is looked upon as highly desirable. Medical assistance on a larger scale is also called for, the population not as yet showing much sign of increase, chiefly, perhaps, on account of the high infantile death-rate. A special chapter is devoted to the tsetse fly, which makes so much of the country comparatively valueless, and the various Governments are called upon for united efforts, possibly on the lines followed by Tanganyika, where Mr. Swynnerton is doing so much. A Publicity Bureau in London, on the lines of those kept up by other colonies, is recommended.

The great importance of scientific research is strongly insisted upon, and especial attention is paid to the almost derelict station at Amani, on which the Germans spent so much money, and which at one time bid fair to rank even with Buitenzorg. Its proper re-equipment under highly skilled direction is recommended, and it is to be hoped that this may be carried out.

The Report should be read by all who are interested in the many problems which East Africa has to solve.

296. *The Development of the East African Colonies, and their Value to Lancashire Trade.* By Sir Sidney Henn, K.B.E., M.P. (Abstr. in *Text. Recorder*, vol. xlii., 505, 1925, p. 54, and in *East Africa*, vol. i., 1925, p. 566, *et seq.*)

297. *The Native East African.* By Hugh S. Stannus, M.D. (*East Africa*, vol. i., 28, 1925, p. 611.)

298. *Some Aspects of Labour.* By "Kalambo." (*East Africa*, vol. i., 23, 1925, and following numbers.)

A good analysis of the position in regard to labour in East Africa, whether independent or dependent.

299. *The European in East Africa.* By Hugh S. Stannus, M.D. (*East Africa*, vol. i., 26, 1925, p. 575.) A discussion of the desiderata for successful work in East Africa from a medical point of view.

300. *The Problem of the Tsetse.* By C. F. Swynnerton. (*East Africa*, vol. i., 28, 1925, p. 609, and following numbers.)

301. GAMBIA. *Cotton Cultivation in Gambia.* (*Bull. Imp. Inst.*, 1924, 22, 482. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 1, 1925, E. 1.)

302. NIGERIA. The *Third Ann. Bull. Agr. Dept., Nigeria*, July, 1924, gives particulars of Date of Planting experiments, Variety Tests, and Spacing and Thinning Tests carried out at the Moor Plantation, Ibadan, in 1923 (pp. 52-54). The experiments carried out at Ilorin are also described (pp. 84-85). Tables showing the details of the various experiments are included (pp. 64-66 and 90-91).

303. *Preliminary Report on the Improvement of American Cotton in Northern Nigeria.* By R. F. Martin and T. G. Mason. (*Third Ann. Bull. Agr. Dept., Nigeria*, July, 1924, pp. 41-43.)

304. NYASALAND. From the Report of the Agricultural Department for the year 1923, recently received, we quote the following:—"Market prices were maintained throughout the year at a level that would have assured profitable returns to the growers, but unfortunately yields per acre were very low owing to the prevalence of the red boll worm (*Diparopsis castanea*), which was responsible for more damage this year than has been the case for a number of years past.

"With a view to reducing the damage done by boll worms, a series of experiments were carried out by the Government Entomologist, and the time of the entomologist on the staff of the Empire Cotton Growing Corporation was devoted entirely to a study of the red boll worm. Special efforts were made during the year to ensure the destruction at the end of the season of all cotton bushes. The time usually allowed to cotton growers was materially shortened and six temporary inspectors were engaged on the work of supervision.

"Under present conditions the margin of profit to a European cotton grower is admittedly small, taking one year with another, and it is only by the adoption of improved methods of cultivation and by skilful management that successful results can be expected when normal prices for cotton rule on the home market."

305. *Nyasaland's Need of the Zambesi Bridge.* By C. Ponsonby. (*East Africa*, vol. i., **29**, 1925, p. 626.)

306. Rhodesia. Dr. Webber, of California University, has been on a tour through Rhodesia, and the *Cott. News Wkly.*, vol. ii., **9**, 1925, p. 237, contains an account of the valuable advice given by him to the Rhodesian cotton growers on the following subjects: the picking, ginning and storage of cotton; the best variety to plant; and the importance of seed selection and of breeding experiments.

307. Rhodesia (Northern). We have recently received a report of the tour through Northern Rhodesia made by Mr. T. G. Hesse, Government Cotton Grader, South Africa, and Mr. T. C. Moore, Cotton Expert, Northern Rhodesia. The main object of the tour was to discuss and arrange matters connected with the sampling, grading, ginning and marketing of cotton, and also to lecture on these subjects to the Farmers' Associations in the districts visited, which included Monze, Mazabuka, Chisamba, Lusaka and Pemba. Mr. Hesse considers that the proposed erection of a ginnery at Mazabuka should prove of great benefit to the industry by enabling quick and efficient marketing of the crop. He is also of opinion that the abnormal weather conditions this season will adversely affect cotton yields, and severe damage may be expected from Jassid, which was found practically all over the cotton districts.

308. Rhodesia (Southern). It is stated in the *Rhod. Agr. Journ.*, vol. xxii., **1**, 1925, that the Experiment Station at Gatooma has now been opened. The total area of land which will eventually be under experimental sowings is 45 acres, of which 25 acres will be available for cotton. Some 14 acres have been planted this season, the experiments to be conducted including variety trials, and fertilizer and distance planting trials.

309. *The Umtali River Irrigation Scheme.* By C. P. Robinson. (*Rhod. Agr. Journ.*, vol. xxii., **1**, 1925, p. 44.)

310. South Africa. *Cotton Levy.* (Abstr. from *Journ. Dept. of Agr., South Afr.*, vol. x., **3**, 1925, p. 194.) At the request of the Minister of Agriculture, representatives of the Central Co-operative Cotton Exchange, Ltd., with the Secretary for Agriculture and the Acting Chief, Division of Tobacco and Cotton, met in the Minister's Office, Pretoria, to consider the expenditure of the cotton levy for the year 1925. It was agreed that the following amounts be allocated from the levy fund:—

	£
Three scholarships at £200 each	600
Co-operative manurial experiments	500
Insectories for the study of cotton pests	500
Office and directors' expenses of the Exchange ..	2,000
Propaganda by the Exchange	500
	4,100

311. *Cotton in South Africa.* From the *Journ. Dpt. of Agr., South Afr.*, vol. x., **3**, 1925, we learn that great and most satisfactory progress is being made this season at the Rustenburg Experiment Station with the breeding and selection of cotton. Thousands of flowers of selected promising strains are being covered or wired to prevent cross-pollination. Some of the previous season's selections are very superior and promise to increase the length of staple and the yield materially. During the two seasons since the Government Cotton Breeder, Mr. A. R. Pullen, has taken up his duties at this institution marked improvement is discernible.

Much damage is being done to the cotton this season by the so-called American boll worm. Sudan boll worm is doing comparatively little damage. An entomologist is investigating boll worm pests at the institution.

From the same source we learn that in some parts of Zululand in January aphis attack was fairly prevalent, the plants that seem to be attacked most being those which have failed to make satisfactory growth on account of unfavourable weather, lack of cultivation, weeding, etc.

312. *Cotton Growing in South Africa under Practical Conditions.* By R. A. Rouillard. (*Cott. News Wkly.*, vol. ii., **8**, 1925, p. 191.)

313. *Prospects and Development of the Cotton Industry.* (*Cott. News Wkly.*, vol. ii., **7**, 1925, p. 159.) Report of an interview with Mr. R. A. Rouillard.

314. From the *Review of the* 1923-24 *Cotton Crop,* recently received from the Agricultural Dept., we learn that the season was one of the most difficult experienced for many a year. Rains in most parts were very late, holding back ploughing, and undoubtedly the acreage was smaller than had been intended. In nearly all areas the young cotton had a hard struggle to keep alive, and it was only some timely rain in January that relieved the position. The Low Veld and Eastern Transvaal then progressed fairly well, but Rustenburg area was very severely handicapped by heavy infestation of locusts. The adverse conditions resulted in the proportion of discoloured cotton being greater than normal, as was also the production of cotton below 1⅛ inches, much of which showed a far more soft and wasty character than usual.

315. *Cotton Progress in Natal and Zululand.* (*Cott. News Wkly.*, vol. ii., No. 11, 1925, p. 287.)

316. (Abstr. from *Cott. News Wkly.*, vol. ii., **10**, 1925, p. 251.) The Zululand Co-operative Cotton Association, Ltd., to which the majority of planters in Zululand belong, has arranged with the African Explosives and Industries, Ltd., to gin and press the members' cotton for 1925 on most advantageous terms. The Central Co-operative Cotton Exchange, Ltd., will sell the lint and seed free of any selling commission.

317. *Cotton Growing in Swaziland,* By D. J. M. Miller. (Abstr. from *S. Afr. Cot. Growers' Journ.*, vol. i., No. 9, 1925, p. 32.)

The average meteorological data are given as follows:—

	Middle Veldt.	*Bush Veldt.*
Altitude, feet	2,500	800
Rainfall, inches	40	24
Abs. Min. Temp. F.	28	30
Abs. Max. Temp. F.	107	105
Mean Temp.	66	70

The country is said to be irrigable at a moderate cost, but labour is somewhat of a difficulty owing to the indolent habits of the Swazis. Ground costs from £1 10s. to £2 10s. per acre. Under the auspices of the Mushroom Land Settlement Company and the 1820 Settlers' Memorial Association the right type of settler is coming into the country, and the author concludes by saying that Swaziland promises to become the best cotton country in South Africa.

318. *A Cotton Pioneer. What the Transvaal Consolidated Land and Exploration Company is Doing.* (*Afr. Cott. Journ.*, vol. i., No. 1, 1925, p. 25).

319. SUDAN. We have recently received the Report of the Government Chemist, Wellcome Trop. Res. Laboratories, Khartoum, for the year 1924. Manurial experiments with cotton are described on p. 31.

320. *Cotton as an International Factor.* By C. F. Tainton. (Abs. from *Afr. Cott Journ.*, vol. i., No. 1, 1925, p. 15.) An interesting discussion of the rise of the Sudan as a new cotton country.

321. TANGANYIKA TERRITORY. *Cotton Production in Tanganyika.* (*East Africa* vol. i., No. 19, 1924, p. 438.)

322. UGANDA. From the ninth cotton report of the 1924-25 season we learn that 147 power cotton ginneries and 3 press houses have already been licensed in Uganda. In the Eastern Province there are 90 ginneries and 2 press houses, in Buganda 52 ginneries and 1 press house, and in the Northern Province 5 ginneries. More ginneries are being built in every province, including 2 in the Western Province. No hand ginneries are now working.

323. *Uganda Labour Problems.* By G. C. Ishmael. (*East Africa*, vol. i., No. 19, 1925, p. 443.)

324. *The Present Position in Uganda.* (*East Africa*, vol. i., No. 19, 1925, p. 553.)

325. AUSTRALIA AND POLYNESIA: QUEENSLAND. (*Queensland Agr. Journ.*, vol. xxii., 6, 1924, p. 412.) In the course of a recent tour made by the Departmental Cotton Specialist, Mr. W. G. Wells, through the Central Queensland cotton areas, the excellent effect which proper spacing and good cultivation had on the development of the fruiting system of cotton plants was strikingly evident. Plants which had been thinned out at the proper time were producing fruiting branches on the fifth or sixth joint above the seed leaves, which were laden with squares and, in many cases, with young bolls, whereas the plants which had been improperly grown were producing only a few small fruiting branches near the tops of the plant. This latter type was usually noticed where the areas cultivated were 20 acres or more in extent, and it is believed that if growers would confine themselves to acreages which they are able to handle efficiently, there would be a marked improvement in the standard of cotton growing. This is shown by the results obtained this season by the growers of Durango cotton, most of whom have restricted their areas to acreages they could properly cultivate.

326. *Demonstration Plots in the Upper Burnett and Callide Valley.* (*Queensland Agr. Journ.*, vol. xxiii., 1, 1925, p. 16.) The policy of establishing demonstration plots in advance of settlement appeared to be much appreciated by landseekers and new settlers in the respective areas thrown open for settlement during the year by the Lands Department. Climatological stations were established to provide authentic records of conditions governing crop production. A series of crop trials at each demonstration area were designed specifically to determine the most suitable varieties to grow. Special attention was paid to Durango cotton. The experiments, both in the Burnett and Callide, embraced "spacing" and "fertilizer tests," with a fair acreage devoted to the propagation of a choice strain for seed purposes. Plant, ratoon, standover, and late-planted plots were also provided for. The aggregate area cropped at each farm exceeded 20 acres. In the Upper Burnett the average return of seed cotton was approximately 1,000 pounds per acre (995 pounds). In the opinion of the Government grader the quality was superior to any other Durango cotton grown during the season in the State.

327. *Cotton—Recent Research Work.* (*Queensland Agr. Journ.*, vol. xxiii., pt. 1, 1925, p. 107.) From a report of experiments carried out at Melton Cotton Research Station we learn that material advantage was obtained by cross-harrowing with a spike-toothed harrow during the early stages of development of the cotton plant, thus reducing the necessity for cultivating with a machine and hand chipping before the thinning period. No injury was caused to the plants, and it is anticipated that in unfavourable seasons the extra mulching will assist in conserving the moisture. Given a good strike of cotton, efficient work with the spike-tooth harrow can be done up to the time of thinning, when the plants are from 4 to 6 inches high.

328. FIJI. The Report of the Department of Agriculture for 1923, recently received, states that the yield of cotton for the year under review was small, owing principally to lack of experience of proper cultural methods on the part of the growers, and to pests. Transport difficulties were also proving a deterrent to the extension of cotton growing.

Efforts were made to improve the industry by the institution of grading measures, the erection of a ginnery, and the hand-cleaning and fumigation of all seed issued for planting. Owing to the depression in the Sea Island market, and the comparatively small lint yield and difficulty in picking this variety, it was proposed to carry out experiments with a view to acclimatizing new varieties of cotton for which there would always be a ready demand.

329. *Cotton Cultivation in Fiji.* By G. Evans, Director of Cotton Culture, Queensland. An interesting and comprehensive report of a tour through Fiji, undertaken at the request of the Empire Cotton Growing Corporation, and by arrangement with the Queensland Government, with a view to determining the possibilities of extending cotton cultivation in the islands.

After describing the general features of the Colony, the author gives valuable information under the following heads: The system of land tenure, population, history of cotton cultivation in Fiji, transport and communication, climatic and soil conditions, the need for experimental and demonstration work, the need for concentration on particular areas, insect pests and diseases, grading, ginning and baling, guaranteed prices and market, lines of development, and the ultimate prospects for cotton cultivation. The cotton-growing possibilities of the different areas visited are also described.

The recommendations put forward by Mr. Evans as the result of his tour are, briefly, as follows:

1. That Crown land on the Nasarawaga river, and on the headwaters of the Lekutu and Dreketi, be surveyed and designed into blocks suitable for Indian settlement.
2. That an additional Cotton Expert be appointed to carry out plant breeding and cultivation experiments on cotton.
3. That an Experimental Farm for cotton be established either near Lautoka or in the Nasarawaga neighbourhood.
4. That one or two itinerant demonstrators be trained by the Cotton Expert to advise growers in the best cultivation and harvesting methods.
5. That the ginning factory at Lautoka be continued for the time being, and, if necessary, a small ginning plant to be erected at Nasarawaga.
6. That experiments be carried out with Durango and Sea Island cotton respectively on selected areas, and that experiments be made with Durango and Meade cotton.
7. That a brief bulletin describing the method of cultivating cotton be published and issued.
8. That the Agricultural Department assume control of all seed; no seed to be imported except through the Agricultural Department.
9. That the existing "close season" regulations be enforced.
10. That Government make a definite statement of policy with regard to guaranteeing the crop for three or four years, and arrange for the prompt payment of the guaranteed sum to the grower as soon as he delivers his cotton at a certain specified depôt.

330. WEST INDIES. We have received from the Department of Overseas Trade the "Report on the Economic and Financial Conditions in the British West Indies," 1924, by J. L. Wilson Goode. Cotton is dealt with on p. 13.

331. ST. VINCENT. In the *Report of the Agr. Dept.* for 1923, recently received, a careful description of the research work in progress is given by Mr. L. H. Burd, Cotton Research Officer. The principal piece of genetical work now in hand is a study of the mode of inheritance of the maximum lint length in cotton, the object of which is to examine the possibility of breeding a cotton possessing a specified lint length with desirable agricultural properties. Other work upon which Mr. Burd is engaged includes a continuation of a variety test on nine pure strains of Sea Island cotton which have been grown in previous years, the collection of material for various pieces of genetical research, a development of the uses of Balls' sledge sorter, and a study of plant development as an aid in crop forecasting.

The Report also contains descriptions of manurial experiments with Sea Island and Marie Galante cottons (pp. 3 and 20), and of the work connected with insect and fungus pests and their control (p. 22 *et seq.*). In addition, an account is given on p. 49 of the working of the Government cotton ginnery during 1923-24.

COTTON IN THE UNITED STATES.

332. PRODUCTION OF STAPLE COTTON IN THE U.S.A. By G. L. Fossick. (*Text. World*, 1925, **67**, Abstr. in *Summ. of Curr. Lit.*, vol. v., **2**, 1925, E. 13.)

333. COTTON CULTIVATION IN THE U.S.A. (*Leipzig. Wochens. Text. Ind.*, 1924, No. **39**. Abstr. from *Summ. of Curr. Lit.*, vol. v., **2**, 1925, E. 9.) A description of new areas in the south-west suitable for cotton growing.

334. COTTON CULTIVATION IN THE UNITED STATES. By A. S. Pearse. (*Int. Cott. Bull.*, 1924, **3**, 260-271. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 21.)

335. CO-OPERATIVE COTTON MARKETING IN THE UNITED STATES. By A. S. Pearse. (*Int. Cott. Bull.*, 1924, **3**, 253-258. Abs. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 20.)

336. COSTS OF COTTON PRODUCTION IN THE UNITED STATES. By A. S. Pearse. (*Int. Cott. Bull.*, 1924, **3**, 244. Abs. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 21.)

337. FIELD CROPS INVESTIGATIONS IN MISSOURI, 1922-23. By W. C. Etheridge, C. A. Helm *et al.* (*Missouri Sta. Bull.*, 210, 1924. Abstr. from *Exp. Sta. Rec.*, vol. li., No. 8, 1924, p. 740.) The superiority of Acala, Mebane Triumph, and Cleveland cotton has been demonstrated in the south-east Missouri lowlands. On Lintonia fine sandy loam an average net profit of $6·60 per acre has accrued from the application of 300 pounds of acid phosphate, which increased the earliness of the cotton crop about 10 per cent. No further profit followed the addition of 35 pounds of potassium chloride.

338. THE RESULTS OF FERTILIZER EXPERIMENTS, 1922-23. By M. Nelson and W. H. Sachs. (*Arkansas Sta. Bull.*, 192, 1924. Abstr. from *Exp. Sta. Rec.*, vol. li., **8**, 1924, p. 725). In the Coastal Plain Section the largest increase in yield of seed cotton during 1922 was produced where manure was reinforced with acid phosphate, and the second largest increase where manure was used alone, followed in order by a heavy application of a complete fertilizer, the lighter application of a complete fertilizer, and a mixture containing nitrogen and phosphorus. The increased yield obtained where nitrogen and phosphorus were used together was more than the combined increase of the plats where these elements were used separately. In the hill section the largest increases in yield of cotton and corn were obtained with manure reinforced with acid phosphate, and the second largest from a heavy application of a complete fertilizer. In the lowland section the heavy application of a complete fertilizer resulted in the largest increases, followed by manure reinforced with acid phosphate.

In the Coastal Plain section the largest increase in the yield of seed cotton during 1923 was produced with the heavy application of a complete fertilizer, followed by that with manure. In the hill section the heavy application of a complete fertilizer showed the largest increase in the yield of seed cotton, and manure reinforced with acid phosphate the largest increase in the yield of corn. In the lowland section the largest increase in the yield of seed cotton was also produced with the heavy application of a complete fertilizer.

COTTON IN EGYPT.

339. The following Technical and Scientific Service Bulletins have been published by the Ministry of Agriculture, Egypt, and can be obtained from the Government Publications Office, Ministry of Finance, Dawawin P.O., Cairo. Price, P.T. 5.

Bulletin No. 47. "Cotton Growing in Relation to Climate in Egypt and the Sudan." By C. B. Williams.

Bulletin No. 50. "A Third Bioclimatic Study in the Egyptian Desert." By C. B. Williams.

Bulletin No. 51. "A Statistical Note on the Cotton Variety Tests at Sakha, 1916-1920." By Trevor Trought.

Bulletin No. 53. "The Effect of Irrigation upon Soil Temperatures." By E. McKenzie Taylor.

Bulletin No. 54. "Notes on the Fungus *Rhizopus nigricans* Ehr., in Relation to Insect Pests of the Cotton Plant in Egypt." By T. W. Kirkpatrick.

Bulletin No. 56. "The Buff-Backed Egret (*Ardea Ibis* L., Arabic *Abu Qerdan*) as a Factor in Egyptian Agriculture." By T. W. Kirkpatrick.

340. ADULTERATION OF SAKELLARIDIS COTTON. (*Manch. Guard.*, January 1, 1925, p. 3. Abstr. from *Summ. of Curr. Lit.*, vol. v., No. 1, 1925, E. 3.) The Egyptian Ministry of Agriculture has decided to ensure the maintenance of pure commercial types by an extensive propagation of selected State Domain strains. The available stocks of seed will be supplied only to cultivators of large areas with a reputation for excellent farming. Under supervision all rogue and impure plants will be removed, and the mixing of seed at the ginneries will be prevented by official inspection. The permanent adoption of this seed farm system will make certain an abundant supply to meet the requirements of all Sakel growers in future years. Pure strains of Assili, "310," Royal Ashmouni and Zagorah will be increased in the same way. This information is supplied by the Royal Egyptian Legation in London, in reply to the rumours concerning the impossibility of obtaining pure Sakel seed for the forthcoming season.

341. RATOON COTTON IN EGYPT. By J. Templeton, B.Sc., Botanist, Ministry of Agriculture, Egypt (Govt. Press, Cairo, 1925, Bull. 55.) The obvious advantages of ratooning cotton—*e.g.*, the saving of labour, and the often large crop—are so great that everywhere many cultivators tend to show a leaning towards this method. The disadvantages, which to most careful agriculturists more than counterbalance the gains, are, perhaps, less obvious. The ratoon plant is six weeks or so earlier than a seedling, and crops better. But unless planted much more widely apart—which brings in other complications—the field becomes a dense mass of vegetation and the later bolls, at any rate, are of poor quality from crowding and from damage by fungus and insects. The ratooned plants are liable to harbour insects and other pests during the winter that would otherwise be fatal to most of them; and in other ways ratooning has great disadvantages.

As a rule, scientific officers concerned with cotton throw the weight of their advice against ratooning, and it is somewhat new to find one arguing in its favour. While the most is made of the good points, the weak ones tend to be minimized, and the experimental evidence which forms the chief argument is lamentably meagre. Only twenty plants were employed, and these were spaced much more widely than usual. Though the crop per plant was large, no evidence is given to show what was the result per acre, though recent work in America goes to show the best crop with very close planting and very few bolls per plant. The bulletin draws conclusions of too great importance from too little evidence. (*Cp.* p. 179.)

COTTON IN FOREIGN COUNTRIES.

342. Cotton Cultivation in Anatolia. By L. Neuberger. (*Leipzig Monats. Text. Ind.*, 1924, **39**, Sonder No. 4. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 2, 1925, E. 7.)

343. Cotton Cultivation in Argentina. By M. T. Meadows. (*Int. Cott. Bull.*, 1924, **3**, 192-195. Abstr. from *Summ. of Curr. Lit.*, vol. v., 3, 1925, E. 15.) The average cost of cotton production in Argentina is 6d. per pound in comparison with 11d. in the U.S.A. There are about 160 million acres with ample rainfall available for cotton growing, and 7 million acres under irrigation. Every other element in the production of cotton is, however, inadequate, but without the dislocation of other industries it is estimated that a million bales can be produced. The season begins with planting from mid-September to mid-November, and picking lasts from mid-February to May and June, or later when there are no early frosts. The low yield per acre of the last season crop resulted from one of the greatest difficulties encountered in Argentina. In certain seasons the plagues of locusts are expected to repeat the 1923-24 experience, but only special well-defined areas are seriously affected. In a small restricted area the pink boll worm is active, but it is hoped to eradicate the pest.

344. Cotton Growing in the Argentine. (*Int. Cott. Bull.*, vol. iii., 1925, pp. 380-383.)

345. Cotton from Asia Minor. (*Times*, January 19, 1925.) An account of the efforts being put forward in Turkey to improve the cotton industry, by the establishment of a ginnery, better classification, etc., and thus to find " a mutually beneficial outlet in the English cotton-spinning districts for her expanding supply."

346. Brazil. We have received from the Department of Overseas Trade the " Report on the Economic and Financial Conditions in Brazil," dated September, 1924, by E. Hambloch. The terms of the decree No. 4793, of January 7, 1924, to "foster the development of the production of cotton," are given on pp. 56-57.

347. Cotton Cultivation in Cambodia. (*L'Avenir Text.*, 1924, **6**, No. 11. Abstr. *Journ. of Text. Inst.*, vol. xvi., **2**, 1925, A. 42.)

348. Cotton Growing in Colombia. (*Int. Cott. Bull.*, vol. iii., 1925, pp. 390. 391.)

349. Cotton Cultivation: Colombia. (*J. Roy. Soc. Arts.*, 1924, **63**, p. 30. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 21, E. 79.)

350. Cotton Production in the Congo Basin. (*Int. Cott. Bull.*, 1924, **3**, 197-200. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 16.)

351. Dominica and Hayti. We have received from the Department of Overseas Trade the Report on the Economic, Financial and Commercial Conditions in the Dominican Republic and in the Republic of Hayti. Cotton is dealt with on p. 47.

352. COTTON CULTIVATION IN DUTCH EAST INDIES. (*Leipzig Woch. Text. Ind.*, 1924, **39**, 954. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 20, 1924, E. 67.)

353. CULTIVATION OF SEA ISLAND COTTON IN DUTCH GUIANA (SURINAM). (*Manch. Guard. Coml.*, 1924, **9**, 610, vol. xxvii., November 27, 1924. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 21, 1924, E. 82.)

354. FRENCH COLONIES. *Cotton in the French Sudan.* (*Cott. News Wkly.*, vol. i., No. 17, 1924, p. 447.)

355. We have received from the Association Cotonnière Coloniale, Bulletins Nos. 68 and 69, containing, among others, interesting articles on "How to develop the production of Colonial Cotton," "Cotton Cultivation in Madagascar," and "Cotton Production in the French Colonies."

356. *Rapport sur la Culture du Coton au Maroc en* 1924. By Georges Carle. We are indebted to the Association Cotonnière Coloniale for a copy of the above report of the Mission sent out by the Association in September last to enquire into the cotton-growing possibilities of the Protectorate of Morocco.

357. *Production Cotonnière dans les Colonies Françaises.* By M. A. Nogues. (*Int. Cott. Bull.*, vol. iii., No. 9, 1924, pp. 143-163.)

358. *Cotton Cultivation in Madagascar.* By Reynier. (*L'avenir text.*, 1924, **6**, 13-24. Abstr. *Summ. of Curr. Lit.*, vol. iv., No. 17, 1924, E. 41.) A report on the possibilities of west and south-west Madagascar as cotton-producing areas. The alluvial plains of the rivers in the west of the island are excellent cotton-growing areas, but insect pests are a definite drawback. A further zone is indicated in which irrigation would be indispensable. The varieties cultivated include "Mananjary," short-staple, and Egyptian.

359. *Cotton Prospects in Madagascar.* By A. L. Oliver. (*Health, Welfare and Safety*, vol. i., No. 2, 1925, p. 13.) The author states that there are approximately 200 square miles of territory in Madagascar at the present moment capable of producing raw cotton of the highest quality. The transport problem has been practically solved, and labour is more readily obtainable as large numbers of coast natives served in France during the War, and are now more willing to work on plantations run by Europeans.

The writer concludes by stating that representatives of firms who are desirous of investigating the cotton possibilities of Madagascar should have a thorough knowledge of the French language and of the French Colonial system of land tenure and taxation.

360. COTTON IN MANCHURIA. (*Int. Cott. Bull.*, 1924, **3**, 217. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 18.)

361. COTTON CULTIVATION IN MEXICO. (*Int. Cott. Bull.*, 1924, **3**, 218. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 18.)

362. COTTON IN MOZAMBIQUE. From the *Cotton News Weekly* we learn that remarkable developments are taking place in Mozambique, large areas being planted with cotton, and ginneries erected at convenient centres.

363. COTTON GROWING IN NEW CALEDONIA. (*Austr. Cott. Grower*, vol. ii., No. 6, 1924, p. 29.)

364. COTTON CULTIVATION IN PARAGUAY. (*Int. Cott. Bull.*, 1924, **3**, 219. Abstr. from *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 19.) Since 1917 the acreage has increased from 125 acres to 30,000 acres, and the crop from 100 bales of 500 pounds to approximately 25,000 bales in 1924. The area under cultivation is expected to reach 100,000 acres in 1925. For the year ending July 31, 1924, 14,000 bales were exported, most of which went to France and Germany.

365. PERU: COTTON-GROWING PROSPECTS. (*Textile Recorder*, vol. xlii., **505**, 1925, p. 107.) Cotton-growing prospects of Peru are likely to be increased considerably by an era of irrigation which has begun in that country. One scheme has recently been completed, and another has just been commenced. There is an ever-increasing demand in Lancashire for cotton from Peru, which only exports at the present time 40,000 tons annually. Irrigated farming is said to give one and a half times the income of unirrigated farming, and it is hoped finally that the production of cotton will advance to the 4,000,000 tons which measures the capacity of the country, as the result of the new enterprise.

366. COTTON PRODUCTION IN PERU. By O. V. Salomon. (*Manch. Guard.*, December 2, 1925. Abstr. in *Summ. of Curr. Lit.*, vol. v., **5**, 1925, E. 38.)

367. COTTON GROWING IN PERU. (*Int. Cott. Bull.*, vol. iii., 1925, pp. 396-97.)

368. COTTON GROWING IN PORTUGUESE EAST AFRICA. By T. Honey. (Abstr. in *East Africa*, vol. i., **29**, 1925, p. 627.)

369. COTTON CULTIVATION IN RUSSIA. By L. J. Lewery. (*Text. Rec.*, 1924, **42**, No. 496, 56. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 14, 1924, E. 35.)

370. COTTON CULTIVATION IN RUSSIA. By S. C. Condrashoff. (*Int. Cott. Bull.*, 1924, **3**, 220-228. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 19.)

371. COTTON CULTIVATION IN SAN SALVADOR. (*Int. Cott. Bull.*, 1924, **3**, 229-230. Abstr. from *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 20.) For the current season a large increase in cotton acreage is reported; 33,000 acres are sown, mainly with Acala, and an average yield of 400-500 pounds per acre is expected.

372. COTTON CULTIVATION IN SPAIN. (*J. Roy. Soc. Arts*, 1925, **73**, 163. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 1, 1925, E. 2.)

CULTIVATION AND MACHINERY: IRRIGATION, ETC.

373. SCIENTIFIC COTTON GROWING AND TRANSPORT. By J. H. Hubbock, of the International Institute of Agriculture, Rome. (*Int. Cott. Bull.*, vol. iii., 1925, pp. 405-411.)

374. COTTON SEED: VITALITY. By W. L. Goss. (*J. Agr. Res.*, 1924, **29**. Abstr. from *Summ. of Curr. Lit.*, vol. v., **6**, 1924, A. 13.) The germinating power has been tested of seeds buried 8, 22, and 42 inches below the surface for one, three, six years, etc. The depth had little effect. None of the edible cereals or legumes or *G. hirsutum* seeds retained vitality even for one year.

375. THE EFFECTS OF HEAT TREATMENT OF COTTON SEED ON ITS GERMINATION AND ON THE SUBSEQUENT GROWTH AND DEVELOPMENT OF THE PLANTS. By James Templeton. (*Tech. and Sci. Serv. Bull.*, No. 18, Min. of Agr., Egypt. Govt. Publications, Off. Min. of Finance, Dawawin P.O., Cairo, price P.T. 5.)

Summary and Conclusions.—1. Germination tests carried out in the laboratory by the Entomological Section and by the present writer fail to show that the germination of cotton seed subjected to heat treatment at the ginneries is adversely affected.

2. When the seeds are sown singly in pots sunk in the soil in the open, differences are apparent in favour of plants from unheated seeds, with regard to rate and quantity of the so-called "field-germination," and also in the average heights and the dry weights of the plants, after a period of sixty-three days.

3. Under normal field conditions, where the seed is sown by handfuls in "holes," and the resulting plants thinned out to two per "hole," the above differences with regard to "field germination" appear to be entirely negligible.

4. Heat treatment of the seed has no apparent effect on the flowering or the yield of the resulting plants.

376. NURSE PLANTING SELECT COTTON SEED. METHODS TO PREVENT WASTE AND AVOID DELAY. By P. V. Cardon. (*Bull. U.S. Dept. Agr.* Abstr. from *Cott. News Wkly.*, vol. i., No. 20, 1924, p. 529.) The method herein suggested substitutes seed of a distinct type of cotton or of beans or peas for those select cotton seeds that produce surplus plants. Thus, in thinning, the number of select seedlings that have to be destroyed is greatly reduced, most of the surplus plants representing other seeds (beans or peas). These plants are stated to be as effective as the select plants in breaking through a soil crust, which is the chief purpose of planting at a high rate.

Methods of planting in hills and in drills with both hand and mechanical corn planters are also described.

377. THE COTTON PLANT IN RELATION TO TEMPERATURE AND RAINFALL. By C. L. Robinson. (Abstr. from *Rhod. Agr. Journ.*, vol. xxii., **1**, 1925, p. 71.) A reprint of an article by J. B. Kincer in the "Monthly Weather Review" of the United States, with the figures for Rhodesia added.

378. SOME FACTORS AFFECTING NITROGEN CHANGES IN BLACK COTTON SOIL. THE INFLUENCE OF MOISTURE CONTENT DURING THE RAINY SEASON ON THE AMMONIFYING AND NITRIFYING POWER OF BLACK COTTON SOIL. By F. J. Plymen and D. V. Bal. (*Agr. Journ. of India*, vol. xx., pt. 1, 1925, p. 9.)

Summary.—1. The effect of the rainfall during the monsoon upon the oxidized nitrogen of black cotton soil has been studied.

2. Figures are given showing the relation between the moisture content of the soil *in situ* and the nitrifying power of the soil.

3. A moisture content of from 24 to 30 per cent. appears to enable black cotton soil to attain its maximum biological activity as regards nitrification.

4. This activity is of a fairly high order, as under the moisture conditions above stated and at the temperature prevailing during the monsoon months 50 to 60 per cent. of added organic nitrogen is oxidized in two weeks.

5. Under the climatic conditions described in the paper, black cotton soil only shows any considerable bacteriological activity during the months from approximately mid-June to mid-October.

6. Laboratory experiments in which definite quantities of water were mixed with air-dry black cotton soil agree with observations made on soil taken direct from the field.

7. Nitrification in artificially watered soils previously air-dried is slower in starting than with soils receiving a natural rainfall, but the nitrifying efficiency, after a period of eight weeks, is about the same.

8. A heavy clay soil which had lost its texture showed at first a diminished nitrifying power when compared with the same soil in good condition.

379. THE CHEMICAL COMPOSITION OF SOIL COLLOIDS. By W. O. Robinson and R. S. Holmes. (Bull. No. 1311, U.S. Dept. of Agr.)

380. SPACING OF ACALA COTTON PLANTS IN SOUTH CALIFORNIA. By H. G. McKeever. (*J. of Agr. Res.*, 1924, **28**, 1081-1093. Abstr. from *Summ. of Curr. Lit.* vol. v., No. 1, 1925, E. 1.) Experiments on the spacing of Acala cotton plants in the Coachella Valley during 1922 and 1923, with plants 2, 6 and 12 inches apart in the row, show the closest spacing to yield equal and occasionally greater crop than those from the widest spacing. The 6-inch spacing is also superior to the 12-inch, but it is inconvenient in field operations; and the practical alternatives are either rows chopped out at 12 inches, or rows from which plants are only removed by hand where the stands are too thick. Some of the lower fruiting as well as the vegetative branches are suppressed in the unthinned rows, but the crowding is lessened by the spreading apart of the plants as they become larger. Widely spaced plants, in contrast, become more crowded as the season advances, owing to the development of many vegetative branches. The 2-inch spaced plants have a greater facility in setting a crop rapidly during favourable periods; and for this reason the practice of leaving the rows unthinned is likely to prove advantageous even in the long-season, weevil-free conditions of the South Western States. The 1923 yield of lint per acre for 2-inch spacing was over 1¾ bales of 500 pounds.

381. GROWTH OF PIMA AND UPLAND COTTON PLANTS. By C. J. King, H. F. Loomis and D. L. Varmetto. (*J. of Agr. Res.*, 1924, **28**, 936-953. Abstr. from *Summ. of Curr. Lit.*, vol. v., No. 1, 1925, E. 2.) Comparative data are presented on habits of growth, flowering, shedding, yields, and lint and boll characters of adjacent plantings of Pima Egyptian and several Upland varieties of cotton grown in Arizona.

382. COTTON PLANT: CARBOHYDRATE NITROGEN RATIO. By E. E. Cheesman. (*Trop. Agr.*, 1925, **3**. Abstr. from *Summ. of Curr. Lit.*, vol. v., **6**, 1925, A. 13.) The onset of the flowering and fruiting stages in plant life is probably determined by the relative proportions of carbohydrates and nitrogenous substances in the tissues, or by some factor intimately connected with the carbohydrate-nitrogen ratio. In the cotton plant the initiation of the flowering stage appears to be, within ordinary limits, independent of external conditions. Vegetative and fruiting branches are produced on a plan characteristic of each variety, and the amount of flower and boll shedding largely determines the yield. Boll shedding is due to water deficiency and to root asphyxiation, but it is in this connection that the carbohydrate-nitrogen ratio may also be important.

383. THE FINEST INSURANCE. (Abstr. from *Afr. Cott. Journ.*, vol. i., No. 1, 1925, p. 11) Describes points that must be attended to in the erection of a ginnery, and recommends the aid of an experienced engineer.

384. DIFFERENT COTTON VARIETIES AND METHODS OF TREATMENT. NOTES ON GINNING, COMPRESSING AND HANDLING. (Abstr. in *Cott. News Weekly*, vol. ii., **8**, 1925, p. 213.)

385. In " Chats about Cotton," *Trop. Life*, vol. xxi., **2**, 1925, gives an account of the use of fans in making conditions healthier for workers in ginneries and spinning and weaving mills.

386. C.O.B. COTTON CLEANING MACHINE: DESCRIPTION. (Whitin Machine Works. Abstr. in *Summ. of Curr. Lit.*, vol. v., **4**, 1925, F. 3.)

387. COTTON IN ST. VINCENT: FORECASTING THE CROP. By L. H. Burd. (*Trop. Agriculture*, vol. ii., **4**, 1925, p. 79). Observations have been made during the past two years on a plot of about 100 plants of BF cotton grown under conditions as alike as possible in each year, with a view to testing the possibility of accurately forecasting the cotton crop. The author arrived at the conclusion that in St. Vincent, and probably in all other places where water is not under control, the bolling rate or size of crop can never be forecasted accurately from the flowering records because of the variable losses by shedding, soft rot, and probably other diseases which cannot be foretold. All that can be done with certainty is to state its time of arrival, and from the total number of flowers produced deduce a possible maximum.

In regard, however, to forecasting in general, another point deserves mention. The examination of bolls from dated flowers indicates that there is a considerable variation in the mean maximum lint length from day to day. Depressions in the lint length are associated with excessive rainfall around nineteen days after flowering, and thus they can be forecasted by approximately three weeks, and such knowledge might possibly be utilized by isolating the cotton picked during a depreciated period, and thus enhancing the chances of uniformity in the product.

388. THE PRINCIPLES OF IRRIGATION ENGINEERING. (With special reference to South Africa.) By F. E. Kanthack. (Published by Longmans, Green and Co. Abstr. in *Afr. Cott. Journ.*, vol. i., No. 1, 1925, p. 31.)

And see 302, 319, 325, 326, 327, 337, 338, 341.

DISEASES, PESTS, AND INJURIES, AND THEIR TREATMENT.

389. BOLL WEEVIL CONTROL. By A. S. Pearse. (*Int. Cott. Bull.*, 1924, **3**, 259-260. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 23.)

390. THE APPLICATION OF SODIUM SILICO-FLUORIDE. By S. Marcovitch. (*Ind. Eng. Chem.*, 1924, **16**. Abstr. from *Summ. of Curr. Lit.*, vol. v., No. 1, 1925, E. 6.) Pure sodium silico-fluoride is an efficient insecticide for the boll weevil. In cage tests all weevils were killed in from 5 to 24 hours. It was also observed that the weevils could be killed merely by contact with the powder. The advantages of this substance over the arsenic compounds are: (1) it is cheaper, (2) it acts as a contact poison, (3) it kills more rapidly, and (4) it is not so poisonous to man. The disadvantage of the commercial product is its density.

391. ARSENIC SUPPLIES AND VALUE IN THE CONTROL OF COTTON BOLL WEEVIL. By H. W. Ambruster. (Abstr. in *Queensland Agr. Journ.*, vol. xxiii., 1925, p. 65.)

392. THE CONTROL OF THE COTTON WEEVIL. (Extract from the *Agr. Journ. of India*, vol. xx., pt. 1, 1925, p. 72.) Find what it is in the cotton plant that the boll weevil likes; produce it in marketable quantities; bait traps with it or mix it with poison, and so lure the insects to their destruction. That is the skeleton of the idea on which scientists of the U.S. Department of Agriculture are working. Dr. Frederick B. Power, the leading biochemist in the Bureau of Chemistry, with the co-operation of V. K. Chesnut, of the same Bureau, is endeavouring to find which of the many complex substances in the cotton plant gives it this peculiar attraction for the weevil, and this is a very difficult task. Large quantities of cotton plants have been subjected to steam and distillation processes, and the substances isolated tested for their power of attracting boll weevils. This part of the work falls to the Bureau of Entomology, where workers watch the behaviour of the insect towards the various substances.

393. COTTON BOLL WEEVIL CONTROL IN TEXAS. By A. B. Conner and H. J. Reinhard. (*Texas Sta. Circ.*, 1924, **32**. Abstr. in *Exp. Sta. Rec.*, vol. li., No. 8, 1924, p. 764.)

And see 444, 445.

394. THE BOLL WORM AND COTTON. By C. Milhurst. (*Austr. Cott. Grower, Farmer and Dairyman*, vol. i., No. 1, 1925, p. 29.) Mr. Milhurst recommends contact spraying rather than dusting.

395. A report from Iraq states that the Entomologist continued during 1924 his observations of the spotted boll worm of cotton. On plants expressly left over for observation purposes this pest continued to feed. The intensity of the attack on these plants remained fairly steady until December 25. Between this date and December 28 it was found that 82 per cent. of the worms had perished from cold. Between December 28 and January 3, although a large number of dead worms were found, no single living worm or pupa could be discovered. It would appear certain that this pest therefore has no hibernation period, but breeds continuously, and that, in consequence, it suffers a high mortality during the winter.

396. CONTROL OF THE PINK BOLL WORM ON COTTON. By C. M. Taylor. (*Nature*, 113, 1924, No. 2847. Abstr. in *Exp. Sta. Rec.*, vol. 51, No. 8, 1924, p. 762.)

397. CONTROL OF THE PINK BOLL WORM IN THE SUDAN. By H. H. King and W. E. Giffard. (*Wellcome Trop. Res. Labs. Entomological Sect. Bull.*, No. 21, 1924. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 1, 1925, E. 5.)

398. THE EFFECT ON COTTON SEED OF STERILIZING AGAINST THE PINK BOLL WORM. By A. P. Kerr *et al.* (Abstr. from *Exp. Sta. Rec.*, vol. li., 9, 1924, p. 804.) Determinations of the free fatty acid content of cotton seed from the same ginning both before and after sterilization, do not indicate that the free fatty acids are increased by the amount of heat required by the regulations for sterilizing cotton seed to kill the pink boll worm.

399. NYASALAND. In the *Ann. Rept. of the Dept. of Agr.*, 1923, recently received, it is stated that the research work carried out in 1923 with a view to evolving control measures for the red boll worm, which is causing serious damage to cotton in Nyasaland, elicited the following information: (1) That there is a distinct rise and fall in the visible amount of boll worm attack coincident with a rise and fall in the percentage of full-fed boll worms found at any specified time. Consequently it is possible to define with a certain amount of accuracy the periods when an individual brood, or the major portion thereof, is just commencing, or *vice versa*, nearing the completion of larval life. (2) From the figures obtained in this work it is clearly indicated that the later broods have a higher percentage value than the earlier ones.

The following measures of control are suggested: (1) A concentrated campaign of "hand-picking" at the very beginning of the season to catch the first brood, on the assumption that any reduction of the first brood must automatically mean a reduction in all succeeding broods; (2) the removal of all first buds and young bolls, in the hope of reducing the first brood of boll worms by depriving them of their normal abundant food-supply. This experiment, although conducted on a very small scale, gave most encouraging results, and of the two may possibly be considered as the more efficacious method of control.

And see 291, 292, 304, 311.

400. THE ANATOMY AND BIONOMICS OF THE RED COTTON BUG, DYSDERCUS CINGULATUS (FABR.). By H. Singh. (*Asiatic Soc. Bengal Journ., and Proc.*, n. ser., 19 (1923), No. 1. Abstr. in *Exp. Sta. Rec.*, vol. li., No. 8, 1924, p. 762.)

401. A FIRST SURVEY OF FACTORS INHIBITING THE DEVELOPMENT OF THE COTTON PLANT IN SOUTHERN NIGERIA. By T. G. Mason and G. H. Jones. (*Third Ann. Bull. of the Agr. Dept., Nigeria*, July, 1924, pp. 11-26.) A detailed study illustrated with numerous diagrams. The conclusions arrived at by the authors would seem to indicate that:

1. American cotton (Allen) is definitely more susceptible to the attacks of insects than is the Native type. Inasmuch as some of these insects introduce fungous and possibly bacterial diseases, the greater susceptibility of the exotic cotton may possess considerable significance. The physiological basis of this differential immunity is not known. It is conceivable, however, that it is the cause of the failure that has attended all efforts to introduce the cultivation of American cotton into a country possessing a long-established Native cotton industry.

2. There are some grounds for thinking that the very marked variation in the yields of American cotton from year to year may be due to variability in the insect population, and this in turn is determined by variations in August rainfall. A very suggestive though far from conclusive correlation is indicated by an examination of the figures for August rainfall and the yield of cotton in different years.

3. The problem has been complicated by the poor yields given by the Native cotton when grown in proximity to American on the Moor Plantation. There seem to be at least two reasons why the Native cotton apparently produces a better crop on native farms. The first is the attraction of the American plant

for cotton stainers, some of which, after their arrival at an area where American cotton is grown, linger on any Native cotton in the vicinity. The second reason is the low water-retaining capacity of much of the soil on the Moor Plantation. While this may not be a matter of great moment to crops that complete, or almost complete, their development before the onset of the dry season (*e.g.*, July sown American cotton), yet it is liable to limit production in plants that do not apparently mature until the close of the rainy season (*e.g.*, Native cotton).

402. JASSID IN ZULULAND. (Abstr. from *Cott. News Weekly*, vol. ii., No. 12, 1925, p. 299.) The presence of jassid has caused much trouble to cotton planters in Zululand. Captain Larmuth, the entomologist lent by Messrs. Kynochs to the Zululand Co-operative Cotton Association to study the question, states that a 4 per cent. nicotine dust applied by a mechanical duster will kill 75 per cent. of adult jassid and 100 per cent. young jassid. It is understood that 5 pounds of dust is sufficient for one acre of planted cotton, the approximate cost being 1s. per pound.

403. COTTON PESTS: THE RED SPIDER. (*Cott. News Weekly*, vol. i., No. 10, 1924, p. 238.)

404. THE SO-CALLED COTTON FLEA. (*Int. Cott. Bull.*, vol. iii., 1925, pp. 413-415.) A report of investigations carried out by Dr. W. D. Hunter, chief of the Bureau of Entomology in the Cotton Belt, on the life and habits of the cotton flea, which is stated to have caused more loss of cotton in some of the coast counties of the Cotton Belt in the past two years than the boll weevil. Dusting the cotton plants with flowers of sulphur is suggested as a means of control.

405. A NEW SERICOTHRIPS (THYSANOPTERA) INJURIOUS TO COTTON. By J. D. Hood. (*Canad. Ent.*, 56 (1924), No. 6. Abstr. in *Exp. Sta. Rec.*, vol. li., No. 8, 1924, p. 762.)

406. A NEW COTTON PEST. (*Journ. Dept. Agr., S. Africa*, 1925, vol. x., No. 1, p. 11.) A leaf and stem feeding beetle, *Syagrus rugifrons*, Baly., which has been known for several years as an occasional pest of cotton in South and East Africa, has caused considerable damage to cotton on several farms in the district of Vryheid and in Zululand.

407. FURTHER NOTES ON INSECTICIDES AND INSECT CONTROL. By C. L. Withycombe. (*Trop. Agriculture*, vol. ii., 5, 1925, p. 97.) A continuation of a previous article in *Trop. Agr.*, vol. i., No. 8, 1924. (*Cf.* 106, p. 68, January number.)

408. INSECTS THAT AFFECT THE COTTON PLANT. By W. Dwight Pierce. (*Cott. News Weekly*, vol. ii., 7, 1925, p. 169.)

409. COTTON DISEASES IN THE SUDAN. ANGULAR LEAFSPOT. (*Report on the Imperial Mycological Conference*, 1924.) At the conference Mr. R. E. Massey gave an account of the diseases of cotton occurring in the Sudan, and the outbreak of angular leafspot (*Bacterium malvacearum*) was described.

The organism is readily isolated, and inoculations proved its pathogenicity. It is always accompanied by a yellow coccus which, however, is not pathogenic. The disease appears immediately after germination in the seed beds, and the effect of humidity and temperature on its course was discussed, detailed data being presented to illustrate this effect. With regard to the question of control, it could be definitely said that the disease was carried over on the seed, and the problem was one of seed disinfection. Disinfectants gave healthy plants, but subsequent infection occurred, contact being sufficient to bring this about. The organism is unable to survive in the soil, and is very susceptible to heat and light in the laboratory. Manure has no effect on the disease. Other allied plants in the Sudan did not become infected, though a case of the sort had been heard of in America. Several disinfectants have been tried, including uspulin, mercuric chloride, "sporocide," lysol, and Jeyes' fluid. There is less fuzz on Egyptian cotton seed than on American, and hence treatment with concentrated sulphuric acid is unnecessary. Lysol and the cresol disinfectants with resin soap gave more efficient wetting, and during the year the whole of the seed of the cotton crop was disinfected with cresol disinfectants. The ideal treatment would deal with the pink boll worm simultaneously with the angular leafspot organism, and the recent work of disinfection of cotton seed by heating to 100° C. *in vacuo* might prove useful. Other diseases briefly described included an obscure disease suspected to be due to *Rhizoctonia*.

410. AN INQUIRY INTO THE CAUSE OF BUD AND BOLL SHEDDING IN COTTON. By P. S. Jivanna Rao. (Abstr. from *Exp. Sta. Rec.*, vol. li., No. 8, 1924, p. 732.) From the work outlined in this paper, confined to *Gossypium herbaceum* (Uppam cotton) growing at Coimbatore, it is concluded that "the shedding, whether of the bud or flower or boll, is brought about in a critical condition of the flower when it is unable to absorb enough water owing to the low osmotic strength of the sap in the growing portions. . . . It is significant that the later stages of bud and boll are not subject to such shedding, which must be accounted for by the superior osmotic pressure they possess for obtaining the sap.

"Boll shedding arises as a consequence of ineffective fertilization or its failure The problem is bound up with the question of how far the plant pays the penalty for self-pollination." The views of other investigators are cited and appraised.

411. COTTON ANTHRACNOSE AND HOW TO CONTROL IT. By W. W. Gilbert. (*Cott. News Weekly*, S. Africa, vol. ii., No. 3, 1925, p. 73.)

412. COTTON PLANT DISEASE: DESCRIPTION. By F. A. Wolf. (From *Forty-Fifth Ann. Rept., N. Carolina Agr. Exp. Sta.*, 1922, pp. 74-76. *Rev. App. Mycology*, 1924, **3**, 703. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 23.) Specimens of young cotton bolls which had been shed at various stages of development up to one-quarter inch in diameter have been examined. Many of the bolls showed elongated, depressed lesions covered with the pink conidia of *Colletotrichum gossypii* on the portion of the pedicels immediately beneath the bracts. In other instances the basal portions of the young bolls were attacked and discoloured. The infection is believed to have originated round punctures made by boll weevils which presumably acted as disseminating agents. This is believed to be the first record of boll shedding due to *C. gossypii*.

413. MILDEW. By F. Summers, M.Sc. (*Textile Recorder*, vol. xlii., **504**, 1925, p. 93.)

414. METHODS OF EXAMINATION OF MILDEWED COTTON MATERIALS. By T. B. Bright. (*Textile Recorder*, vol. xlii., **505**, 1925, p. 58.)

415. We have received a copy of "Gold Coast Plant Diseases," by R. H. Bunting and H. A. Dade, from which we quote the following paragraph relating to cotton :

"*Cotton Rust, Kuchneola gossypii* (*Lager*) *Arth.*"—The only cotton disease of which we have records for this country was found on material received from the Sisal Hemp Plantation near Accra. It is caused by a fairly widespread fungus, and has been reported from Togoland and Dahomey. It is not known what species of *Gossypium* it affects here, but in Togoland its host is recorded as *G. barbadense*, L., and it appears to be most commonly found on perennial species. The leaves are dotted with small, yellowish-brown spots on the under surface, and by small purplish-brown spots on the upper surface; defoliation follows infection."

416. CONCERNING CORRELATIONS BETWEEN CERTAIN SOIL MOISTURE CONSTANTS AND CRINKLE OF THE COTTON PLANT. By C. H. Wright and T. G. Mason. (*Third Ann. Bull., Agr. Dept., Nigeria*, July, 1924, pp. 31-40.)

Summary.—1. Attention is drawn to an affection of the native cotton (*G. peruvianum*) in the Ibadan area characterized by a recession of chlorophyll from the leaf margins and a crinkling of the lamina. The term *crinkle* is suggested for this condition of the plants.

2. The correlation found between this condition of the plants and the hygroscopic coefficient of the subsoils is considered to favour the view that crinkle possibly owes its origin to the inability of the subsoil to supply moisture at a rate high enough for the normal functioning of the leaves.

3. No relationship was found between lint diameter and any of the soil characters examined. A low correlation is suggested between lint length and the soil's water-holding capacity.

417. SEED-BORNE DISEASES. By Prof. S. F. Ashby. (*Trop. Agriculture*, Trinidad, vol. ii., No. 1, 1925, p. 8.)

418. THE EFFECTS OF RAIN ON COTTON SEED. By R. Y. Winters. (*Int. Cott. Bull.*, 1924, **3**, 271. Abstr. in *Summ. of Curr. Lit.*, vol. v., No. 3, 1925, E. 22.)

419. DISEASES OF CROP PLANTS IN THE LESSER ANTILLES. By W. Nowell, D.I.C., Assistant Director of Agriculture, Trinidad and Tobago. (London: West India Committee.) There are mycologists who remain simply mycologists (or students of fungi), without obtaining the necessary insight into the other side—the agricultural, the crop, or the host side—to enable them to deal fully with the problems that confront them. The usefulness of such men, whether when they are dealing with individual outbreaks of disease, or when they are generalizing in book form, suffers from this one-sided outlook. The attack of a disease may be countered sometimes on the side of the parasite, sometimes on that of the host, and to be of the greatest service the mycologist must understand both. The book before us is a refreshing change from books that have a purely mycological outlook, and deals with diseases from both sides. It tries to show in any given case where the weak points in the attack are to be found, so that the disease in turn may be attacked at those points; and also where the defence will bear strengthening, so that at those points the agricultural practice may be improved. At times, of course, only one of those two methods appears to be feasible, but this does not in any way detract from the value of a thorough study of both sides of the question, such as Mr. Nowell has carried on.

The first part of the book, dealing with diseases in general, seems to us to contain a good deal of matter with which every mycologist will necessarily be familiar, and which will not interest the practical agriculturist; but the second part, which deals in detail with individual diseases, is excellent, and should find use beyond the bounds of the Lesser Antilles, for which the book is primarily written. Many of the diseases are more or less universal in the tropics, and the general method of treatment and the consideration given to both sides of the problem—mycological and agricultural—make the book one which can be strongly recommended.

BREEDING, GENERAL BOTANY, ETC.

420. OCCURRENCE OF COTTON FLOWER STOMATA. By P. S. Jivanna Rao. (*Bot. Abs.*, 1924, **13**, 886. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 18, 1924, A. 45.) The author found stomata in the epicalyx, calyx, anther surface, epidermis of the ovary, style, non-hairy portion of the stigma, and ovules of the cotton plant. In each instance the guard cells contained starch.

421. THE STRUCTURE OF THE COTTON HAIR AND ITS BOTANICAL ASPECTS. II. THE MORPHOLOGY OF THE WALL. By H. J. Denham. (*Journ. Text. Inst.*, **14** (1923), No. 4, pp. 86-113T, pls. 8, figs. 26. See Abstr. *Exp. Sta. Rec.*, Abstract No., vol. xlix., **6**, 1923, p. 528.)

422. FIELD CROP EXPERIMENTS IN NORTH CAROLINA, 1922-23. By C. B. Williams and C. D. Matthews. (Abstr. from *Exp. Sta. Rec.*, vol. li., **9**, 1924 pp. 831-832.) A method for determining rapidly the density of fibre population on the cottonseed coat, employing a sharpened leather punch for cutting out a section of the seed coat, and then counting the fibres, has been very satisfactory. It is claimed to be much superior to methods previously recommended, in which the area of the seed must be determined. Close spacing of cotton has yielded highest, although furnishing a slightly shorter staple.

423. SEA ISLAND COTTON. (*Int. Cott. Bull.*, vol. iii., 1925, pp. 420-426.) An excellent account of this cotton, from which, as of general and historic interest, we quote the first two paragraphs, though the whole of the article is of considerable interest:

"This season marks the disappearance from American agriculture of the Sea Island cotton industry, once a flourishing enterprise in South Carolina, Georgia, and Florida. For generations an American monopoly, growing of this renowned cotton has been virtually abandoned in the face of inroads of the Mexican boll weevil, which have made the production of extra-staple cotton exceptionally precarious. To be sure, some experimental plants are being maintained in anticipation of a possible revival, but the commercial output has been so greatly reduced that Sea Island consumers of long standing have been driven to seek substitutes for this variety, which was formerly their main dependence.

"Practically all the Sea Island cotton now grown in the world is produced in the West Indian Islands. Some fine cotton of this order is also being cultivated in Surinam or Dutch Guiana on the mainland of South America adjacent to the southernmost group of the islands. Phenomenal yields have been reported there from experimental fields. Soils of the neighbouring British Guiana, however, have been found unsuitable for this crop. Sea Island culture has been tried out at various times and in various parts of Africa, notably in the Italian dependency of Eritrea, French Dahomey, Nigeria, the Union of South Africa, and Southern Rhodesia, but no development of importance has resulted. Cultivation in a small way has been attempted likewise in Hawaii and in the South Sea Islands of Fiji and North Borneo. Sea Island is an established crop in Peru, but only negligible amounts are available for the export market from this small industry."

424. INHERITANCE OF CERTAIN CHARACTERS IN GOSSYPIUM. By K. I. Thadani. (*Agr. Journ. of India*, vol. xx., pt. 1, 1925, p. 37.) The conclusions arrived at by the author are as follows:

1. Forms which are indistinguishable phenotypically may not have the same genetic constitution, and hence the mode of inheritance in certain crosses may vary for the visibly similar characters in other crosses. Hence plant breeders are cautioned not to accept the results of crossing experiments as being generally applicable without reference to the types involved in the cross.

2. Most of the characters of economic significance show dominance in the F_1 generation, and hence the desirable combinations are not so easy to segregate as would be the case if the desirable character were recessive. In the case of seed fuzziness it is, however, found that the fuzzy seed is recessive to naked seed. Since many of the American Upland cottons often contain a few naked seeds, advantage of the recessive nature of the fuzzy seed may be taken in purifying the crop by mechanically removing the naked seeds.

3. The significance of the study of the mode of inheritance in staple crops is of vital interest in agriculture, since improvement of crops is one of the most fundamental lines of progress.

425. COTTON HAIRS: FUNCTION. By N. W. Barritt. (*Ann. Appl. Biology*, 1924, **11**, 310-311. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 20, 1924, A. 53.)

426. The *Queensland Agr. Journ.*, for vol. xx., pt. 5, 1923, gives a photograph of an eight-lock cotton boll from the Mount Larcom District. The usual number of locks found in cotton bolls of American type in Queensland is either four or five, and the boll depicted is an interesting departure from the normal.

And see 287, 453.

427. HYBRIDIZATION OF COTTON. By T. L. Bancroft. (*Austr. Cott. Grower, Farmer, and Dairyman*, vol. i., No. 1, 1925, p. 35.) The author thinks that "the bogey of hybridization has obsessed the cotton experts and their understudies to such an extent that it is becoming intolerable."

LEGISLATION.

428. NIGERIA. *Regulations* (No. 22 of *November*, 1924) amend Clauses 10 and 12 of the Cotton Export Regulations.

429. NYASALAND. *Notice No.* 6 *of January*, 1925, provides for the uprooting and destruction of all cotton plants of the last preceding planting by a fixed date.

Notice No. 7 *of January*, 1925, cancels Notice No. 181 of 1923, referring to the Cotton (Uprooting) Rules of 1923.

430. RHODESIA (NORTHERN.) *Ordinance No.* 7 *of June*, 1924, provides generally for the regulation of the export of cotton lint and for the sale of cotton seed.

Government Notice No. 101 *of July*, 1924, prohibits the export of seed cotton or cotton lint except under certain specified conditions.

Regulations of July, 1924, deal with the ginning, grading, baling, and marking of cotton.

431. RHODESIA (SOUTHERN.) *Government Notice No.* 338 *of June*, 1924, prohibits the transit of ginned cotton through Southern Rhodesia from Northern Rhodesia except under certain specified conditions.

432. SOUTH AFRICA: SWAZILAND. *Proclamation No.* 19 *of July*, 1924, amends the Swaziland Cotton Growing Proclamation of 1921.

Notice No. 89 *of July*, 1924, deals with the additional regulations issued with Proclamation No. 19 of 1924.

Notice No. 111 *of September*, 1924, provides that all cotton lint consigned for export overseas through a port in the Union of South Africa shall be subject to the regulations regarding inspection, grading, etc., that are ruling at such port.

433. UGANDA. *The Cotton (Control Board) Rules*, 1924, provide for the establishment of a Cotton Control Board to advise generally on all matters connected with the welfare of the cotton industry in Uganda.

434. QUEENSLAND. *An Order in Council of January*, 1924, provides for the acquisition by the Government of all seed cotton grown in the State of Queensland before July 31, 1924.

A Proclamation of January, 1924, states the period of duration of the Government guaranteed price for seed cotton during 1924.

Regulations of January, 1924, give the prices guaranteed to growers by the Government for seed cotton during 1924.

An Order in Council of May, 1924, deals with the question of ratoon and stand-over cotton.

An Order in Council of June, 1924, amends the Order in Council of May, 1924, with regard to ratoon cotton.

Additional Regulations under the Cotton Industry Act, 1923, *dated August*, 1924, provide for the registration of all prospective cotton growers.

The Cotton Industry Act, Amendment Act of 1924 (*No.* 14 *of October* 28, 1924), amends in certain particulars the Cotton Industry Act of 1923.

A Proclamation of November 8, 1924, states the date by which all cotton plants of the first growth after planting shall be either cut down or destroyed, and all cotton plants which are not the first growth after planting shall be destroyed.

A Proclamation of November 15, 1924, states the date by which all debris of cotton plants shall be burnt.

An Order in Council of January, 1925, provides for the acquisition by the Government of all seed cotton grown in the State of Queensland before August 31, 1925.

A Proclamation of January, 1925, states the period of duration of the Government guaranteed price for seed cotton during 1925.

Regulations of January, 1925, give the revised prices guaranteed to growers by the Government for seed cotton during 1925.

435. GRENADA: WEST INDIES. *A Proclamation of July*, 1917, prohibits the importation into the Colony of cotton seed or seed cotton from any country or place other than the Colonies of St. Lucia and St. Vincent, except under special licence granted by the Governor or the Superintendent of Agriculture.

CHEMISTRY AND PHYSICS IN THEIR APPLICATION TO COTTON PROBLEMS.

Under this head the number of publications is so great that we shall be obliged in future only to mention those that seem to us to have important bearings upon the work carried on in laboratories (other than textile testing institutions) in the cotton zones.

The bulk of the titles that would, had space permitted, have been mentioned here, are extracts from the following, among other journals:

Shirley Institute Memoirs.
Journal of the Textile Institute.
Textile Recorder.
Summary of Current Literature.
Leipziger Monatsschr. Text. Ind.
Textilberichte.
Science, etc.

436. COTTON YARN: STRENGTH. By H. Reimers. (*Faserstoffe u. Spinnpflanzen*, 1923, **5**, 32; from *Mitt. deutsch. Forschung Inst. Textilstoffe*, Karlsruhe. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 13, 1924, L. 23.)

437. THE STRENGTH OF COTTON AND ITS PRODUCTS. By F. W. Kuhn. (*Textilberichte*, 1923, **4**, 420-422. Extracted from the *Journ. of the Text. Inst.*, vol. xiv., No. 11, 1923, A. 255.) Comparing the strengths of some cotton in the form of fibre, yarn, and cloth, the author found that the yarn strength was about 37 per cent. and the fabric strength about 70 per cent. of the breaking strength of the fibre. This is explained by the greater slipping of the fibres in the yarn than in the fabric, and leads to the conclusion that "staple length" is much less important in determining fabric strength than in the case of yarns.

438. THE RELATION BETWEEN THE BREAKING STRENGTH OF COTTON YARNS AND THE TWIST AT THE PLACE OF BREAKING. By W. English, M.Sc. Tech. (*Journ. of Text. Inst.*, vol. xv., No. 8, 1924, T. 385.)

439. OUTSIDE COTTON: SPINNING. By J. Winterbottom. (*Text. World*, 1924, **65**, 190-191; and **66**, 875-877. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 14, 1924, G. 35.)

440. THE SPINNING OF COTTON WASTE. By James Reed. (*Text. Rec.*, No. 502, **42**, 1925. Abstr. from *Summ. of Curr. Lit.*, vol. v., **2**, 1925, G. 4.) A general article on the classes, possible uses, selection, and spinning of cotton waste. In an editorial note the lack of appreciation in England of the great possibilities of the cotton waste trade is deplored.

441. COTTON WASTE SPINNING. By S. Wetherell. (*J. Manch. Coll. Tech. Text. Soc.*, 1924, **14**, 54-59. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 17, 1924, G. 43.) A general account of the processes of cotton waste spinning and manufacturing.

442. COTTON: STAPLE TEST. By Ernst Müller. (*Leipz. Monats. Text. Ind.*, 1924, **39**, 346-347. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 19, 1924, L. 31.)

443. COTTON LEAF SAP: PHYSICO-CHEMICAL PROPERTIES. By J. A. Harris, Z. W. Lawrence, W. F. Hoffmann, J. V. Lawrence, and A. T. Valentine. (Abstr. in *J. of Text. Inst.*, vol. xv., No. 7, 1924, A. 161.)

444. COTTON PLANT: ALKALINITY. By J. E. Mills. (*Science*, 1924, **60**, 268. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 18, 1924, A. 45.) The dew collected from the cotton plant is alkaline, and it seemed possible to the writer that this alkalinity is connected with the attraction of the cotton plant for the boll weevil. The following experiments were therefore made. The leaves and stems of young cotton plants were crushed and immersed in water containing a few drops of phenolphthalein. No apparent alkalinity was produced. When the unbruised plant was used it was found that the under side of the leaf, the tender buds, and very tender stems showed an alkaline reaction, no evidence of which could be observed on the upper side of the leaf or older parts of the stems, etc. On exposure of the under side of the leaf to the sun no apparent diminution in alkalinity took place. Many different kinds of leaves were tested. Similar though much less alkalinity was noticed in the case of okra leaves. Okra is related to the cotton plant, and the boll weevil can be forced to feed on it.

445. COTTON PLANT: ALKALINITY. By F. B. Power and V. K. Chesnut. (*Science*, 1924, **60**, 405. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 21, 1924, A. 58.)

446. THE PHOSPHORUS CONTENT OF COTTON. By A. Geake, Ph.D. (*J. Text. Inst.*, vol. xv., No. 3, 1924, T. 81.)

447. QUANTITATIVE VARIATION OF GOSSYPOL AND ITS RELATION TO THE OIL CONTENT OF COTTON SEED. By E. W. Schwartze and C. L. Alsberg. (*J. Agr. Research* (U.S.), **25**, 1923, No. 7, pp. 285-295.)

448. THE DETERMINATION OF NITROGEN IN COTTON. By B. P. Ridge. (*J. Text. Inst.*, vol. xv., No. 3, 1924, T. 94.)

449. SOME PHYSICAL MEASUREMENTS ON COTTON FIBRES AND THEIR GRAPHICAL REPRESENTATION. By T. Barratt. (*J. of Text. Inst.*, xiii., 1922, No. 10, pp. 220-228.)

450. THE PHYSICAL CAUSES OF THE LUSTRE IN COTTON. By Albert Adderley, A.R.C.S. (*J. of Text. Inst.*, vol. xv., No. 4, 1924, T. 195.) The well-known fact that certain varieties of cotton are characterized by their lustre is often ascribed to their "fineness." The present investigation, based on actual photometric measurements, shows, however, that the only physical factor which affects the lustre is the shape of the cross-sections. Cotton hairs which tend to be circular in section are more lustrous than flattened hairs. This accounts for the superior lustre obtained on mercerization, especially under tension. Of the material examined, there was not a specimen, even of mercerized cotton, which was really circular in section, suggesting that there is a possibility of obtaining still better lustre with mercerized cotton, either by improving the mercerization process or by better choice of the raw cotton employed.

451. CELLULOSE: SPONTANEOUS COMBUSTION. (*Zellstoff. und Papier*, 1923, **3**, 17-18. Extr. from the *Summ. of Curr. Lit.*, vol. iii., No. 16, 1923, B. 74.) The

German Materialprüfungsamt, acting as arbitrators in a case of the firing of a stock of air-dry soda cellulose, declared that no instance of the spontaneous combustion of cellulose has ever been recorded or presumed, except where the material has been associated with oxidizable fats or oils.

452. CONVOLUTION OF THE COTTON HAIR. By A. Herzog (*Leipz. Monats. Text. Ind.*, 1924, **39**, 284-286. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 18, 1924, A. 45.) A general article on the convolution of the cotton hair, its causes, and factors affecting the degree of convolution. A table is given showing the number of right- and left-handed and undeveloped convolutions for fifty-eight divisions each 0·63 mm. long from the tip to the base of a single Sakel cotton hair. The direction of the convolutions is discussed in connection with the striations in the hair wall, and it is shown that the direction of convolution is always the same as that of the striations in the outer layers. The author agrees with Bowman's theory of the alterations in convolution direction.

453. CONSTITUENTS OF COTTONSEED OIL. By G. S. Jamieson and W. F. Baughman. (*J. Oil and Fat Industries*, 1924, **1**, 30-34. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 19, 1924, B. 90.)

454. OIL CONTENT OF COTTON SEED. By A. F. Sievers. (*J. Oil and Fat Industries*, 1924, **1**, 56-61. Abstr. in *Summ of Curr. Lit.*, vol. iv., No. 19, 1924, E. 62.) Some studies on the oil and ammonia content of samples of cotton seed from various Experimental Stations are described in connection with an attempt "to develop varieties of cotton that will yield fibre of maximum value and seed containing the maximum percentage of oil, and also to determine the effects of cultural conditions." The work is described in very general terms, but it appears that the best seed—large, fully developed, and very rich in oil—was obtained under irrigation. Moreover, under all the diverse conditions at the stations, the relative rank of the different varieties as regards yield of oil was, with few exceptions, constant.

455. COTTON SEED: TOXICITY. By E. W. Schwartze and C. L. Alsberg. (*J. Agr. Res.*, 1924, **28**, 173-189. Abstr. from *Summ. of Curr. Lit.*, vol. iv., No. 17, 1924, B. 78.) A comparison has been made of the toxicity of pure gossypol with that of four variations of cottonseed kernels containing known quantities of gossypol. The results indicate that the toxicity of cottonseed kernels is due to their gossypol content. Further, the gossypol content of cottonseed kernels varies with the different cotton-producing regions. This explains the variations in the toxicity of cottonseed press cake and meal made in different regions by the same manufacturing process.

Experiments on cats and rabbits have shown that pure gossypol is capable of producing nearly all the manifestations reported as characteristic of the cottonseed intoxication of farm animals. Gossypol, therefore, is the principal causative agent of cottonseed poisoning.

456. COTTONSEED MEAL: TOXICITY. By C. T. Dowell and P. Menaul. (*J. Agr. Res.*, 1923, **26**, 9-10. Abstr. in *Summ. of Curr. Lit.*, vol. iv., No. 22, 1924, B. 107.)

CO-OPERATION.

457. AN INTERNATIONAL INSTITUTE OF CO-OPERATION. (*Queensland Agr. Journ.*, vol. xxiii., pt. 2, 1925, p. 164.) A development of considerable significance in agricultural co-operation is the decision reached unanimously at a meeting of farmers' organizations and co-operative undertakings held at the Department of Agriculture, Washington, U.S.A., and attended by the late Secretary for Agriculture, Mr. H. Wallace, to hold a conference this year for the purpose of founding an International Institute of Co-operation in the United States.

The project is purely educational. In a memorandum setting out the aims and purposes of the Institute, its promoters observe that the general conception of the principles underlying the co-operative movement is vague, uncertain, and idealistic, and that a more thorough understanding of the theory, history, and technique of co-operation is necessary if the successful application of these principles and the realization of their acknowledged possibilities for good to the business interests and general welfare of the country, are to be accelerated.

The immediate objects of the conference are stated to be:

1. To collect and make available a body of knowledge concerning the co-operative movement in the United States and in other lands.
2. To serve as a means of clarifying thought as to what the co-operative movement really is, and of bringing about more harmony and unity of action among organizations directly or indirectly connected with co-operation.
3. To serve as a means of training and developing leaders and workers in respect to co-operative theory and practice.
4. To serve as a means of assisting educational institutions to improve their teaching courses in co-operation.
5. To focus the spirit of the co-operative movement as a means of community and national development.

The session will last about four weeks, and it is the intention of the organizers to invite to America for the occasion the leading authorities on the co-operative movement in various parts of the world, as well as a number of students.

458. CO-OPERATION IN ZULULAND. It is stated in the *S. Afr. Cott. Growers' Journ.*, vol. i., No. 7, 1925, p. 26, that the Zululand Co-operative Cotton Association will undoubtedly prove one of the most flourishing Co-operative Societies in South Africa in the near future. The membership is over sixty, and is steadily increasing. The Association hopes to enrol every cotton grower in Zululand as a member, and the Directorate is leaving no stone unturned to acquire every benefit possible for the members. It is anticipated that the output of the Association for 1925 will be well over 3,000,000 pounds of seed cotton.

459. HOW TO FORM A CO-OPERATIVE SOCIETY IN NEW SOUTH WALES. By H. A. Smith. (*Agr. Gaz. of New South Wales*, vol. xxxvi., **1**, 1925, p. 27.)

460. PROGRESS OF CO-OPERATIVE SOCIETIES IN CEYLON. (*Trop. Agriculturist*, vol. lxiv., **3**, 1925, p. 173.) The Co-operative Societies in Ceylon continue to show progress; twenty-five new ones have been registered during the past year. The total capital at the end of the year amounted to Rs. 238,000, and the loans to Rs. 352,000.

461. THE CO-OPERATIVE MOVEMENT. Speech made by Sir Leslie Wilson at the opening of the Bombay Provincial Co-operative Conference. (*Tropical Agriculturist*, vol. lxiv., **2**, 1925. Reprinted from the *Mysore Econ. Journ.*, vol. x., No. 12, p. 116.)

MISCELLANEOUS.

462. COTTON PRICES: WHY AMERICA WILL CONTROL COTTON MARKETS. (*Afr. Cott. Journ.*, vol. i., No. 1, 1925, p. 16.)

463. COTTON INDUSTRY: ECONOMICS. By G. W. Daniels. (*Text. Manufr.*, 1925, No. **51**. Abstr. in *Summ. of Curr. Lit.*, vol. v., **5**, 1925, M. 11.)

464. STATISTICS: APPLICATION. By G. Udny Yule. (*Indus. Fatigue Res. Board*, Rep. 28, 1924 (H.M.S.O.). Abstr. from *Summ. of Curr. Lit.*, vol. v., **4**, 1925, M. 8.) A plain elucidation of the function of statistical method in scientific investigation, particularly as applied to the study of industrial fatigue.

465. OPERATIVES, EFFICIENCY OF. By W. A. Daley (Abstr. in *Journ. of Text. Inst.*, vol. xvi., **3**, 1925, A. 107.)

466. NEED FOR FRESH COTTON FIELDS. (*Agr. Journ. of India*, vol. xviii., part vi., 1923, p. 653.) An instructive lecture on "Cotton and Some of its Problems" delivered at the Textile Institute, Manchester, by Mr. Walter R. Dunlop, Professor of Economics at the West Indian Agricultural College.

467. ARTIFICIAL SILK. Many people interested in cotton have a lurking fear that a formidable rival is springing up in the shape of artificial silk. All who desire to know about the latter should look at the *Manchester Guard. Coml.* of May 5, 1925, which is devoted to artificial silk. The production in the world for 1924 is estimated (p. 20) at 62,797 metric tons, a weight which would make 251,088 bales of 500 pounds each. Of this, the United States accounts for 16,000, England and Germany for 10,000 each, and Italy for 8,000 tons. An account is given of the four processes by which suitable substances are made into artificial silk: (1) viscose process (p. 23), starting from wood pulp; (2) cellulose acetate process for cotton linters and wood pulp (p. 35); (3) the cuprammonium process (p. 37) for cotton linters, and to a less degree for wood-pulp; and (4) the Chardonnet process for cotton (p. 39). Many other subjects are dealt with, and on p. 56 is an article on the attitude of the Lancashire cotton industry, which is said to be following the development of artificial silk with interest, while considering that it can never oust cotton.

468. THE USES OF COTTON SEED. (*S. Afr. Cott. Growers' Journ.*, vol. i., No. 8, 1925, p. 25.)

469. THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD. A supplement to *Trop. Agriculture*, vol. ii., 3, 1925, contains three interesting articles on the Imperial College of Tropical Agriculture, written respectively by Sir Francis Watts, Principal Emeritus; Dr. H. Martin Leake, Principal; and Major H. C. Corlette, the architect of the new building.

In the article by Sir Francis Watts an account is given of the origin of the West Indian Agricultural College and of the subsequent expansion of the scheme to its present Imperial status. The second article, by Dr. Martin Leake, contains a description of the new building of the Imperial College of Tropical Agriculture, at which the following training facilities will be available:

1. A full Diploma course such as is given at a University or University College.
2. Facilities for post-graduate work.
3. Facilities for research on problems of interest in tropical agriculture.
4. Technical courses, and especially courses in sugar technology.

Major Corlette, the architect, contributes a note describing in detail the design and construction of the new College building.

470. TRINIDAD AS A POSSIBLE SITE FOR A CENTRAL RESEARCH STATION. By Professor J. B. Farmer, M.A., D.Sc., F.R.S., and L. G. Killby, B.A., B.Sc. (E.C.G. Corporation, 1925). The sub-committee appointed to consider the question of a central research station, where general problems can be investigated that have to do with cotton, have been at work for a considerable time. They have gone very carefully into the claims of many different parts of the Empire, and in the end it seemed as if Trinidad offered the most generally favourable conditions. Professor Farmer and Mr. Killby were asked to report in greater detail, and visited Trinidad for the purpose. In this report they recommend the establishment of a station near the Imperial College at St. Augustine, with a geneticist and a physiologist as the chief officers, and an advisory committee of two: Dr. Martin Leake and Mr. Nowell, both already resident in Trinidad, and both with much experience of cotton and of research. An area of thirty acres is available, and probably other thirty beside that, and a fully equipped laboratory is recommended, with the needful subordinate staff. The neighbourhood seems climatically and otherwise suited to cotton, and has the advantage that cotton is not commercially grown there, so that there should be no difficulty with crossing. Climate and health conditions are good, the Imperial College is close by, and Trinidad is readily accessible from England.

471. COTTON RESEARCH: NORTH CAROLINA, U.S.A. (*Cotton*, 1925, **89**. Abstr. from *Summ. of Curr. Lit.*, vol. v., **6**, 1925, M. 15.) The North Carolina State College has appointed James McDowell (fifteen years ago with J. and P. Coats) to direct research along the following lines: (1) a study of the cotton hair from various areas of North Carolina and elsewhere, with reference to bleaching, dyeing, and mercerizing properties; (2) testing different yarns and cloths to determine shrinkage. strength standard, etc.; (3) testing starches and dyes; (4) study of waste due to imperfect line and improper use of machinery; (5) testing uses of cotton for mechanical purposes; (6) studying designs and finishing methods; (7) study of mills in North Carolina and their equipment.

472. RAIN-GROWN COTTON AND CLIMATE. By E. E. Canney, B.A. (*Shirley Inst. Mem.*, iii., **24**, 1924.) An excellent general study of the climatic conditions of the world from a cotton growing point of view. It shows very well the regions in which, without irrigation, it would be futile to attempt the cultivation of cotton, but is on much too small a scale to be any guide to the regions where it would be practicable, except in the most vague and general way. Nothing but local experiment can decide.

473. A revised and enlarged edition of "Statistical Analyses of the Cotton Industry" has just been issued by the Merchants National Bank of Boston as part of the bank's cotton statistical service. It is even more comprehensive than previous editions, containing much statistical material which has not been readily available heretofore. The new publication covers practically all the basic phases of the world's cotton trade.

As in previous editions, all the tables in the book give the latest figures on the subjects treated, and those consisting of weekly or monthly figures are arranged so that they may be kept up to date week by week by the insertion of the current figures which are furnished by the bank. Most of the tables give comparative figures for five years or more, thus providing an unusually broad basis for analyzing the statistical situation in the trade. The statistics on production, stocks, consumption, and movement of cotton are compiled as nearly as possible on a uniform basis as to bale weights and inclusion or exclusion of linters to facilitate comparison and analysis.

The book has been compiled by Alston H. Garside, director of the bank's cotton statistical service, who has been engaged in cotton statistical research for eleven years.

PERSONAL NOTES

APPOINTMENTS.

Southern Rhodesia.—Mr. J. G. Hamilton has been appointed by the Corporation as Cotton Breeder to assist the Southern Rhodesian Government.

Swaziland.—Mr. R. Cecil Wood has been appointed by the Corporation as Cotton Specialist in Swaziland.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street) immediately opposite to the offices of the Crown Agents for the Colonies.

At the date of writing the following officers are on leave in England from cotton-growing countries:

Gold Coast	Mr. G. H. Eady.
,, ,, ...	Mr. A. W. Paterson.
,, ,, ...	Mr. J. E. Symond.
Kenya	Mr. P. Booth.
Nigeria	Mr. P. H. Lamb.
,, ...	Mr. A. J. Findlay.
,, ...	Mr. J. O. Hewitt.
,, ...	Mr. A. G. G. Hill.
,, ...	Mr. C. H. Jones.
,, ...	Mr. R. Nicoll.
,, ...	Mr. A. W. J. Pomeroy.
,, ...	Mr. H. Roebuck.
Nyasaland	Mr. N. D. Clegg.
Sierra Leone	Mr. D. W. Scotland.
Uganda	Mr. A. R. Morgan.
,, ...	Mr. J. D. Snowden.

The following officers of the Corporation are at present on leave in England:

Mr. S. Milligan (South Africa).
Mr. H. C. Ducker (Nyasaland).

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REVIEW

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SUMMARY OF REPORT ON TRINIDAD AS A SITE FOR A CENTRAL COTTON RESEARCH STATION

BY

PROFESSOR J. B. FARMER, F.R.S., AND MR. L. G. KILLBY.

INTRODUCTION

In view of the decision of the Corporation to adopt the recommendations contained in the following Report and to establish a Central Cotton Research Station in Trinidad, it may not be amiss to state clearly, though in general terms, what is, in the view of the Corporation, the scope of the work of that Station, so that there may be no misconception as to the functions which it is believed it can and cannot discharge.

In the first place, emphasis should be laid on the distinction between those problems, on the one hand, the solution of which will lead to an extension of our general knowledge of cotton and of the ultimate conditions which govern the development of the plant and the properties of its lint, and on the other hand, those which are primarily local in their origin and can only be fully solved under the conditions of the locality in which they arise.

A general description in one sentence of the work to be undertaken would be, that it is intended to investigate there the cotton plant in all phases of its growth and under rigorously controlled conditions, so that it may be possible to ascertain and to estimate the importance of the several factors which contribute to the final result. On the other hand, what it is not intended to do is to provide strains of pure line seed for large-scale distribution to the cotton fields in different parts of the Empire. The effect of the acclimatization factor on the properties of any particular type of cotton renders it essential that the production of seed for this purpose must be carried out in the several countries themselves, and the utmost that a Central Station can do in this direction, wherever it may be situated, is to breed out pure lines for special characteristics. These in their turn will have to be *locally* tested in different parts of the world in order to find out whether they are satisfactory in any particular country, and so to serve *in that country* as a starting-point from which it can raise its own seed.

Among the investigations which it is intended to conduct at the Station may be mentioned, merely as examples, a study of the mechanism of the growth and behaviour of the cotton plant, its reaction to its environment and of the connection between the characteristics of the lint and its spinning qualities. As explained in the Report, the fact that cotton *can* be grown in a limited area within Trinidad, but is not grown on a commercial scale, renders the Island in very important respects the more suitable for the purpose of a Research Station.

While it is hoped that the Station will so justify itself by its work that it will be adopted by cotton workers in the several parts of the Empire as a central clearing-house at which local problems can be further investigated under standardized conditions, its establishment will in no way relieve Departments of Agriculture of the necessity of continuing the scientific side of their research work on cotton. Local problems can mostly best be solved locally, but the experience which the Central Station should accumulate should enable it to suggest where and how any particular problem should be attacked with the greatest prospect of success, and thus enable it to be of assistance to all cotton research workers. Furthermore it is hoped that it will provide a scientific link between growers and manufacturers. It is in this latter capacity that the Corporation regard it as essentially important that close touch should be maintained between their Research Station and the British Cotton Industry Research Association, and free interchange of information should be maintained between the two bodies.

While this Introduction will have served a useful purpose if it prevents misunderstanding as to the objects which the Corporation believe can be secured through the work of the Station, a further word of warning may not be out of place. Botanical research, owing to the nature of its material—the growing plant—is not a rapid process, and, for the same reason, cannot be expedited. It is only by a steady and systematic study of the several factors that have to be taken into account that such additions can legitimately be expected to our knowledge of the cotton plant as should lead to results of benefit to both growers and spinners alike.

FOREWORD.

BY

DR. W. L. BALLS, F.R.S.

In May last the Executive Committee of the Corporation adopted a proposal to establish a Cotton Experiment Station for the British Empire.

The changes brought by the last eight years make it difficult to realize what a visionary I felt myself to be when I began to dream, in 1911, of a Cotton Experiment Station which should serve the cotton fields of the British Empire in somewhat the same way as Rothamsted serves all agriculture in temperate climates. I was then working at Giza, and the steady accumulation of records year by year, together with the endless rush of new problems, made it self-evident that some permanent and far-reaching scheme of this kind was awaiting its genesis. Moreover, Giza was then the site for it: six days from London, a dependable climate, a decent soil, the best of all labour, a metropolis within cycling distance, and no difficulty in getting or keeping good staff.

But my dream was merely Utopian. There was the practical difficulty that many of the lines of research with which Giza bristled were of no cash value to Egypt; they might increase the general knowledge of cotton, but without bringing exclusive, or even prior, advantages to Egypt itself; and, after all, an Agricultural Service is a business proposition of a sort. So the money, for what in my own mind I called a Cotton Rothamsted, would have to come from outside —which was nowhere. The agricultural services in most parts of the Empire at that time were notorious Cinderellas, and by no stretch of the imagination could they be in a position to finance an ideal difficult of attainment and possibly, in their view, of doubtful value. The cotton industry was even less likely to do so; it certainly had the beginnings of a contact with cotton growing through the International Federation of Master Cotton Spinners' Associations, but, as a whole, its interest in raw cotton did not reach beyond the broker; to say that growing and spinning were equal and interdependent parts of one industry was regarded as merely an ingenious paradox.

If the spinner were unlikely to offer help, still less likely was Egypt to have accepted such help had it been offered. The spinner was the bogyman who would not pay fair prices; Government departments were scared at any attempt at intercourse with him; and a fantastic atmosphere of suspicion and muddle surrounded the pre-war study of cotton, in Egypt at all events, whenever one foot was advanced across the parochial boundary.

Then came the war; and however much less the peace may be than our hopes, the two together have given us a cotton industry which is more self-conscious, more homogeneous, and better organized for the acquisition, dissemination, and application of new technical knowledge than was even imaginable in 1911. The " overseas man " on leave can get into touch through the Empire Cotton Growing Corporation and the British Cotton Industry Research Association in a single day with more people and more suitable people than in a whole summer's leave ten years ago.

And one result is that Utopia has been achieved, though not in Egypt, but in Trinidad.

My purpose in the remainder of this note is to show how it is to the imagination and knowledge of Mr. J. W. McConnel, whose death in 1922 was such a loss to the industry, that we owe this achievement. And the transition is a remarkable step, for the foundation of this station is an act of faith: of faith in the immensity of our ignorance about cotton; of faith that knowledge is future power, acting in directions quite impossible for present ignorance to predict.

I summarized some of my schemes in 1914;* and the formation of the British Cotton Industry Research Association and the Empire Cotton Growing Corporation, which both began under Mr. McConnel's chairmanship, gave him the opportunity to carry these forward and improve on them. His first statement of the interrelation between plant biology and cotton spinning was in a paper published in March, 1914;† and at the International Conference of Tropical Agriculture a few months later he emphasized the evident importance (in the Yield × Price product) of purity of strain. Thus far he had not made distinction between local and general problems; but in 1918 the distinction appears in print in a discussion of the many kinds of work covered by the word " research."‡ The passage is worth quotation:—

" Important as it may be to the future of all cotton growers and all cotton users to learn the true nature of the physiological development of the cotton fibre, and the limitations and possibilities of heredity, it is obviously unreasonable to expect any particular cotton growing community to bear separately the cost of such work. It is, indeed, of real importance that this distinction of the kinds of research work necessary should be specially considered in relation to the proper apportionment of the cost."

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* *Science Progress*, October, 1914; *Worralls' Textile Gazette*, November and December, 1914.

† *Textile Mercury*, March 21, 1914.

‡ *Ibid.*, March 16 and 30, and April 6 and 13, 1918.

The Provisional Committee on Research and Education for the Cotton Industry held its second meeting on January 10, 1917, and approved his suggestion that " the Growth of the Fibre " should be on a par with " Spinning Processes, Fabric Construction, etc.," as a subject for research by the proposed Research Association. At a later meeting he stated, " There is need not merely for work on the growing of cotton, but also for work bearing on the methods by which cotton can be grown to spin well."

The early plans for the Research Association had included the foundation of an Experiment Station in Egypt as a semi-independent organization, with a liaison through the Botanical Department of the Association. A skeleton draft, dated January 4, 1918, sketches the field for the work of such a station thus:

" The relative efficiency and limits of (*a*) heredity; (*b*) environment. How far either can be favourably modified by science. Research in growth and use of cotton must go hand in hand."

The following paragraph shows that by approaching the position from the spinners' side, Mr. McConnel had now recognized that there was scope for general research on cotton growing as distinct from that on local agricultural problems:

" Egypt offers an unequalled site for the location of Imperial Institutions devoted to the concentration of knowledge and to organization of Experimental Research as to the nature and possibilities of the cotton plant and its product, cotton lint. Such institutions could work in close correspondence with the scientists in other cotton-growing parts of the Empire, and could maintain personal intercourse and collaboration with the consumers in Great Britain and (if necessary) in India."*

Steps were being taken to obtain official opinion from Egypt concerning the possibility of starting work on the Experiment Station when the first overt signs of the Egyptian crisis arrested them. Meanwhile, the Empire Cotton Growing Corporation had absorbed Mr. McConnel's energy; and as the B.C.I.R.A. evidently had its hands full with purely industrial problems, it was agreed, through a joint committee of the two bodies, that overseas work, including the

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* Report on the Cotton Supplies of the British Empire after the War.

Experiment Station, should be left to the Corporation, provided that close liaison could be maintained.

By 1919 the prospect of using Egypt was diminishing, but the need for the creation of a Cotton Growing Research Institute abroad was increasing.

The details of the formation of the Corporation henceforth left Mr. McConnel little time to consider the Experiment Station, and after his death the project flagged. In 1922 it was judged by the Research Committee to be an ideal rather than an immediate practical possibility; but the developing needs of the B.C.I.R.A. enabled the matter to be brought up again through the Joint Committee, and a special sub-committee of the Corporation undertook a survey of the Empire for possible sites. Their elimination of every place other than Trinidad, after very thorough examination and careful consideration, led the Executive to send Professor J. B. Farmer and Mr. L. G. Killby to report on the possibilities of this island, with the result that it has now been adopted as the site of the Corporation's Cotton Experiment Station.

SUMMARY OF REPORT ON TRINIDAD AS A SITE FOR A CENTRAL COTTON RESEARCH STATION.

There are many fundamental problems connected with the cotton plant and with the properties of its lint, the investigation of which does not fall within the duties of the scientific specialists on the Agricultural Staff of any single cotton-growing country, who have not, moreover, as a rule, had the requisite training to fit them for such work, nor have they the time to do it if they had. Since, however, the successful solution of such problems may be confidently expected to lead to results of the highest value to the cotton industry, the Corporation intend to establish a Central Research Station, whose special function shall be the study of such problems rather than the investigation of local difficulties, which in most instances can better be studied in the country in which they originate.

Prior to recommending the establishment of one central station, the Corporation considered very carefully the possible alternative of subsidizing institutions in different parts of the Empire to carry out research work on the cotton plant. The reasons which led them to reject this alternative were briefly as follows: if the work is not concentrated at a central station it is impossible to focus it on a common line of attack on any particular problem, nor can there be effective co-operation between the different branches—*e.g.*, genetics and physiology. Secondly, results and records would be scattered, thus making continuity of record impossible and reference by other workers difficult. Thirdly, there would be no one recognized place to which problems could be referred for investigation from the different parts of the Empire, and there would be no possibility of ascertaining the precise conditions under which any particular result was obtained, and of repeating those conditions in another experiment, whereas these would be standardized and recorded if there were only one central station. Apart from these reasons, there are obvious practical difficulties: the research workers in cotton-growing countries are all fully occupied on local problems, mostly in connection with plant breeding and selection work for the immediate practical purpose of improving the seed supply of the localities in which they work. The Corporation would, therefore, be faced with the impossible task of providing additional suitably qualified research workers at each of the institutions which it was decided to subsidize, instead of having to staff only one central station. Moreover, the facilities for research, where they exist at all, are already fully taxed, so that considerable expense would have to be incurred in extending the laboratories at each place. The further disadvantages that might result from having a Research Station near commercial cotton crops are referred to below.

As regards the site for the Research Station, the Corporation consider that so long as most types of cotton can be grown in the place selected, it is of less importance whether the conditions are typical of any large area of potential cotton-growing country, for the following reasons:—Firstly, in any large area of potential cotton-growing country cotton would almost certainly be already grown as a commercial crop, or would be so grown in the future, and the establishment of a Research Station and the consequent introduction, for experimental purposes, of many different types of cotton would almost inevitably give rise to economic difficulties owing to the danger of hybridization of the commercial varieties with others grown at the Research Station, unless there were exceptional facilities for isolation of the experimental crops, and special care were exercised in the disposal of their seed. In addition, it is only too likely that any fresh troubles from pests or diseases that might develop in the commercial cotton crops would be laid at the door of the Research Station which, however unjustly, would be thus brought into local disrepute.

Secondly, it is a matter of general knowledge that whenever cotton raised in one place is transplanted to another, the effect of acclimatization can only be determined by experience. Whether, therefore, the conditions at the Research Station are characteristic of large, or only of small, areas of cotton-growing countries, this acclimatization effect will, in either case, have to be reckoned with in growing elsewhere cottons raised at the Research Station. On these grounds the Corporation attached greater importance to other factors, including those mentioned below, in the selection of a site.

In the first place, the Corporation set themselves the task of defining what are the determining factors by which their choice should be governed; they agreed upon the following: (*a*) suitability of the site selected to grow cottons of many different kinds; (*b*) accessibility from England; (*c*) good climate for scientific workers; (*d*) availability of intelligent field assistants; (*e*) proximity to an existing university or college. Having regard to the fact that the Corporation's chief activities are in Africa, they first examined the suitability of possible sites in that continent. The Sudan was rejected mainly on the ground of its trying climate and the special conditions under which the plant is there grown in the irrigation areas; the Transvaal and Natal, partly owing to the comparatively long and expensive journey from England. The Corporation attached great importance to the advantages to be derived from close proximity to a university or college of standing, but it does not appear that Pretoria itself, which alone could provide close contact with the university there, is advantageously situated for that purpose, lying as it does at an altitude of 4,471 feet above sea-level. Outside Africa, Ceylon and Cyprus were among the other places whose claims were fully discussed, but, though possessing certain advantages, these were outweighed by their drawbacks.

After thus exhaustively examining the possibilities of several different parts of the Empire, it was agreed that Trinidad might be found to possess more advantages and fewer disadvantages than any other place that appeared in any way suitable for the purpose.

The fact that the Imperial College of Tropical Agriculture in Trinidad had recently appointed as their new Principal Dr. H. Martin Leake, and that Dr. S. C. Harland was professor of botany there, was naturally a factor in favour of Trinidad, since the valuable research work on cotton that has already been done by Dr. Leake in India and by Dr. Harland in the West Indies and in this country is universally recognized, and it would consequently be a great advantage to the Research Station if it were so situated that they could interest themselves in its work. As a result the Corporation appointed the authors of the Report to visit Trinidad, to ascertain whether any conveniently situated part of the island fulfils adequately the climatic and other requirements necessary for the object which they had in view, in spite of the fact that the greater part of it (though not the whole) is less suitable for cotton growing on a commercial scale than for some other tropical crops. A summary of the Report is given below.

Suitability of Trinidad for Growing Cotton : Historical.—In view of our instructions, it was evident that we were required to examine the possibilities of Trinidad from the point of view of its suitability for the cultivation of many different types of cotton experimentally rather than for the production of any one type in commercial quantities. Nevertheless, the fact that cotton had formerly been grown as a commercial crop in the island on a small scale, and had since been abandoned, might clearly have an important bearing on the object of our visit, and early steps were taken to investigate the history of cotton production in Trinidad. Sir Francis Watts, with his long experience of agriculture in the West Indies, very kindly undertook to prepare a note on this subject for us, and the thanks of the Corporation are due to him for the time and trouble that he was good enough to give to this task during the pressure of other work.

In this note Sir Francis Watts states that attempts made some twenty years ago to establish cotton in Trinidad as a commercial crop were unsuccessful. Analyzed in the light of present knowledge, the failure was due to three causes: (1) Some of the sites selected have probably the worst soil for cotton in the island; (2) they were situated in parts of the island where the rainfall is heavy—and in this connection it may be mentioned that the variations in rainfall are considerable within comparatively short distances; (3) the cotton was planted so that it matured about the wettest time of the year. Among the record of failures the only success that was achieved was on the St. Augustine estate by Mr. McInroy, whose cotton is reported to have been of excellent quality and to have sold at a good price. This exception is noteworthy because in our view there are several miles of country in this neighbourhood, and extending eastwards at the foot of the northern range of hills, which are unquestionably suitable for cotton in respect of both soil and climate, and after careful consideration of these and other relevant factors, it is at St. Augustine that we recommend the Corporation to establish their Research Station.

From the point of view of an experiment or research station the fact that cocoa, coconut, and sugar have proved, and are likely to continue to prove, more attractive to estate owners, is extremely fortunate. Not only are we freed from the difficulty arising from the risk of hybridizing commercial crops of cotton from several varieties grown for experimental purposes, which would prove a formidable obstacle to the establishment of such a station in any place possessing a cotton-growing industry, but the task of controlling pests is at once rendered easier by the absence of any extensive area from which they can draw their food supplies. Moreover, the prospect of being able to destroy any alternative host plants within the migratory range of the pest is more hopeful in view of the small area of country that need be considered from this aspect.

Climate.—Since examination of the history of cotton in Trinidad held out hopes that a part of the island might be found to be well adapted for the Corporation's purpose if the correct site were chosen, our attention was next turned to a consideration of the climate. We confess to having originally felt a doubt as to whether the rainfall might not prove to be excessive and too sporadic for the successful cultivation of cotton. A study, however, of the rainfall and temperature records at the Government Experiment Farm at St. Augustine and a comparison with similar records for the principal cotton-growing States of America, for the chief cotton-growing islands of the West Indies, and also for countries in tropical Africa where the crop is grown, convinced us that there were no grounds for the view that had been put forward that there might be a considerable risk of losing the crop on account of excessive rain during the ripening season. Exceptional rainfall may occur in Trinidad as in other countries, but the risk is certainly no greater than it is elsewhere, though naturally the time of planting must be so selected that the cotton ripens in the dry season (January to April).

Dr. S. C. Harland, Professor of Botany at the Imperial College of Tropical Agriculture, was also consulted as to the suitability of Trinidad for experimental cotton growing, and his reply was wholly favourable with respect to the climatological conditions. Dr. Harand was good enough to prepare answers to a questionnaire dealing with this and other matters.

The answers given by Dr. Harland to our questions related to the climate and soil of the St. Augustine district of Trinidad in particular. and describe his experience of experimental cotton growing there, He gave details of the diseases and pests which may be expected to attack the crop, and stated that up to the present none had caused serious damage to his plots; in fact, so far it had not even been necessary to adopt control methods. He referred to the fact that the College land had hitherto not been under cultivation, so that the soil was poor. Nevertheless, even with very little manuring, his crops are already giving satisfactory yields.

Suitability of the Climate for Scientific Work.—The climate is warm, with an agreeably steady temperature; it is, however, humid, especially, of course, during the rainy season. The mean annual temperature is about 78° F., but in the winter months it often falls below 70° at night. The north-east trade winds blow for most of the year. The staff at the College do not find that the climate in any way interferes with their work, and the conditions generally are more pleasant than in most other parts of the tropics, though, of course, the high humidity during the rainy months is doubtless rather trying and enervating. Sunstroke is unknown, malaria is neither widespread nor particularly serious, and typhoid is rare. Trinidad is out of the hurricane zone.

Available Land and its Soil Characters.—At this stage, then, we had satisfied ourselves on two points: firstly, that so far from there being factors which rendered Trinidad unsuited for our purpose, it possessed many advantages; secondly, that as regards both soil and climate, the St. Augustine district was the best in the island from the cotton-growing standpoint. We accordingly next directed our enquiry towards the possibility of obtaining land at St. Augustine, and as near as possible to the Imperial College of Tropical Agriculture, the great advantage of which is obvious.

We were fortunate in finding that there is within 500 yards of the College a belt lying immediately to the south of the northern hills, extending from St. Joseph eastward towards Arima, where the texture and composition of the soil and the slope of the ground appear to be very suitable for the growth of cotton. Furthermore, this belt occurs in the area which, from the point of view of rainfall, is probably the best in the island. As a result, the Corporation have secured a lease of 30 acres of Government land in this area, and have purchased another 30 acres adjoining it from private owners. The soil is generally similar to that at the College and at the Government Station, so that the results obtained with cotton at the two latter places may be accepted as confirmatory evidence as to the suitability of the soil and climate in this area for cotton. At the Government Experimental Station agricultural experiments have been carried out with cotton for some years, and both Upland and Sea Island have been grown. During recent years the experiments have been mainly with the latter type, which has given an average yield during the past three years of over 230 pounds of lint per acre on an area of 2½ acres.

At the College, Sea Island, Egyptian, six varieties of American Upland, Indian (six types), Chinese and several miscellaneous kinds have all been grown this year (which has not been a specially favourable one), and with the exception of two pedigree selections of Upland, all varieties have given satisfactory yields. The cottons are naturally not immune to diseases and pests, but it was specially noted that the cotton stainer, which has caused such extensive damage in some of the islands, has not proved serious, and we were particularly struck by the small amount of boll-shedding.

On the site selected there is a surface soil, rather heavy in character and about 18 inches in thickness, overlying a siliceous subsoil of a porous nature, though containing much silt. It was clear that the water-lifting capacity is good, and at the same time there is no clay or other obstacle to deep root run. We found that roots of the Black Sage (*Cordia*), which has overgrown the land, had penetrated to a depth of 7 feet. Thus it is evident that physically the soil is satisfactory. It is rather poor in composition, but this is no disadvantage from the point of view of an experiment station; indeed, it offers the great advantage that it is admirably fitted for investigations on manuring, etc. It is obviously a simple matter to enrich poor land in any way that may be required for purposes of experiment, for the cost of doing so is inconsiderable in comparison with the value of the information which it is desired to obtain. On the other hand, from land rich in lime, for example, it is practically impossible to eliminate the effects of this constituent. Again, results obtained on rich alluvial soil are incapable of being properly tested with reference to special, or even to ordinary, conditions, and recourse must be had to precisely those types of soil which do admit of modifications as adumbrated above—that is to land originally possessing just the properties that characterize the soil in the area that we are recommending for the station. The soil contains practically no lime, but its acidity is scarcely perceptible.

On the area of 60 acres it will be possible to arrange for a separate isolation plot. In all agricultural work there is a risk that some disease or pest may descend on the plots, and sweep through the whole area, causing the loss of valuable pedigreed material. This risk can only be effectively guarded against by the isolation of a certain amount of the material on a separate plot situated apart from the rest of the station. There is no need for the isolation plot to be large, nor need it be far from the main plots. The spread of a disease may often be stayed, and the damage wrought by a pest may at least be minimized by interposing belts of another crop which thus serves to break the cotton crop up into separate plots.

Furthermore, the provision of sufficient land allows scope for a rotation, so that the cotton plots may be changed over on to other land as often as is desirable. Another reason for ensuring that the area of the station is adequate is that we also envisage the station as constituting in the future the central clearing-house at which problems encountered in sub-stations, such as the Corporation's present Experiment Station in Nyasaland, will be worked out under standardized conditions, either by the staff in Trinidad, or by members of the staff at such a sub-station seconded temporarily to Trinidad for the purpose. It may be desirable to make it clear here, however, that the primary object of the station should be to carry out investigations, and not to serve as a seed farm at which pure strains would be multiplied for distribution to other countries. Such multiplication of seed grown originally at a central station can only be carried out satisfactorily in the several countries themselves, because the effect of the acclimatization factor can only be ascertained by experience.

Cropping Scheme.—It is recommended that only about 20 acres be planted each year in cotton, the remainder being in sugar-cane. Any tropical soil tends rapidly to lose organic matter, and it is found that cane leaves land in first-class condition for cotton, both as regards manure and tilth. Indeed, cane forms about the best possible rotation crop for cotton for the following reasons:

1. Its close habit of growth enables weeds to be easily killed out.
2. It improves the soil because it has roots which decay in the ground, and the trash, which is used subsequently as a mulch and then incorporated in the soil again, contains a large proportion of the mineral constituents which the plant has taken out.
3. The sugar and the cellulose, of which the cane sent to the factory and not returned to the land mainly consists, are derived not from the soil, but from water and carbon dioxide of the air.
4. Given sufficient area the same land would be under cotton every third year only. This rotation is economically sound, because cane has to be manured, and the land thus receives the manure required for the cotton, and simultaneously a profitable crop is grown.

Staff and Scope of the Work.—We have given careful thought to the question of whether, from within the wide field of subjects that call for research, a choice can be made of any one or two as a starting-point at which work can be begun on a modest scale, and from which later developments can follow naturally. As a result, we are strongly of opinion that cotton genetics and physiology are subjects that urgently demand research, and they would form a satisfactory starting-point for obtaining valuable information, and a nucleus from which, later on, other work would certainly grow. A scheme of work based on these two subjects represents the minimum scale on which, in our view, it would be worth starting a Research Station at all, but, at the same time, it is one from which results of fundamental importance to the industry may not unreasonably be expected.

We regard the provision of adequate staff and facilities for work in *genetics* as of first importance; only in this way can production of desirable varieties with the implied fixity of characters be ensured. It will be recognized that such work is very laborious, and involves the treatment and examination of a very large amount of living material, and that this work must, for each cropping season, be completed within fairly definite limits of time. It is on the results of such an organized examination of the properties of individuals of each year's crop that the planning and seeding for the production and testing out of the qualities in the succeeding generations must depend. Unless such work is under thoroughly able scientific direction, much waste of effort must be entailed, and the securing of really tangible results of economic value may be greatly, or even indefinitely, postponed. In other words, the " hit and miss " methods are almost sure to lead to results far inferior to those that otherwise might reasonably be anticipated. They will, moreover, always in the long run prove far more expensive to reach than those arrived at by a really competent scientific investigator directing the work of a trained and well-organized (though not necessarily a large) staff. We therefore recommend the appointment of a chief genetics investigator and at least one first-rate scientific assistant.

As next in order of importance to genetics we would press for the appointment of a *plant physiologist*. The relations of the plant to soil, to climatal and general physical environment, and the connections between water, whether as rainfall or soil water, and the yield, together with the quality of the crop, are still imperfectly understood, and urgently call for investigation. Such work cannot but prove to be of high importance in the commercial production of cotton. Moreover, there are many problems with which the geneticist is concerned, in which assistance from a physiologist is of material importance. The effect of different physical conditions on such pronounced genetic properties as length and strength of lint

EMPIRE COTTON GROWING CORPORATION

An increase in the world's supply of raw cotton has already become a matter of the most urgent importance; it is hoped, therefore, that all those interested will aid the Corporation in their endeavours to extend the cultivation of cotton within the British Empire. They can assist in this direction by making the work of the Corporation as widely known as possible, and for this purpose it is hoped that subscribers for the Journal will be forthcoming from all cotton-growing parts of the Empire.

Subscribers are reminded that this number completes Vol. II. It is hoped that all those who have already subscribed to the first two volumes will continue their subscriptions.

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may be cited as an instance of what is meant. Like the geneticist, he should be given a competent understudy as chief assistant.

Both of these senior officers will require other, but less skilled, laboratory and field assistants as well.

On whatever scale the work of the Central Research Station is planned, it must be remembered that the results there obtained will not necessarily, or even probably, be found to hold without modification in other regions, where the soil and climate may be very different. But the basic principles discovered will be of wide application; and for this reason it will be necessary that the station shall be central not in name only, but shall serve as a means of suggesting appropriate investigations to be conducted in other cotton-growing lands, where the different factors (of climate, soil, and the like) that may influence the actual behaviour of the cotton plant in such countries may be carried out, perhaps under advice from the central station. Even qualities of cotton that may be regarded as "genetically fixed" may be found to be affected by climatal variation, and such matters will form proper problems for further elucidation. This touches on the whole question of acclimatization, concerning which much remains to be learnt. We visualize the possibility of members of the staff in the central station being detailed for service to solve special problems elsewhere, and with the accumulating experience that such a station should be in a position to gather, such mutual contact must prove of advantage to the cotton-growing industry as a whole. It should be regarded as a part of the duties of the staff to travel, and, though this may not be feasible to any great extent in the first year or two until the work of the station has settled down and is running smoothly, an item should be allowed for this in the estimate of annual expenditure. If the work is to be kept in close touch with other work on cotton elsewhere, it is essential that those in charge of it should be required to take opportunities from time to time to make themselves familiar with the problems that present themselves under different conditions of soil and climate both in America and in the cotton-growing countries of the British Empire. The value of such visits to the successful prosecution of the work of the station is so obvious that it does not require to be argued at further length. Moreover, from the nature of their work it is most desirable that the staff should be encouraged, or even required, to take study leave at home periodically, and it is hoped that the question of the value of study leave will be borne in mind when the terms of the appointment of the research workers are being decided. Thus, to sum up this paragraph, it may be said that whilst many, perhaps the great majority, of problems can be attacked definitely in a well-chosen central station, there will always be others, arising out of diversity of physical conditions, which will call for local investigation also before their complete solution can be found.

Though the *practical* end, from the cotton manufacturer's point of view, may be quantity and quality of lint, the achievement of this end cannot be expected (except by chance) without patient investigation of the cotton plant in all phases of its growth, and under such rigorously controlled experimental conditions as will make it possible to ascertain and estimate the importance of the many several factors which contribute to the final result. The history of the progress of investigations at Rothamsted suffices to show how complex the relations of a plant to its surroundings actually are, and how much needs to be learnt before one is in a position to control results intelligently. It may be regarded as certain that an Experiment Station founded to deal with the cotton plant cannot expect to exhaust, within a short period, the wide range of problems that demand solution. Experience shows that new problems continually arise above the horizon as others are more clearly apprehended or disposed of. If a central station is properly to discharge its functions, it is bound to grow as the range of its problems increases, and for this reason alone foresight should indicate the need from the beginning of providing that its later activities should not be cramped by lack of space for future extension. It should be in the position of becoming the clearing-house for all cultural problems, and though it may be that in no one spot could the conditions be found which would enable *every* problem to be attacked *there* with reasonable hope of success, it should be able to decide *where* and *in what manner* such problems should be investigated. Obviously climatal differences alone might determine in favour of one or other locality as specially suitable for this or that type of cotton plant which it may be desirable to investigate, but the overwhelming advantage of possessing a specialized and skilled staff, accustomed to deal with this class of investigation, available (as they only could be if a central station were maintained) for such service, need not be further laboured.

The scientific work that has already been done on the cotton plant and its lint has emphasized how much still remains to be elucidated in the fundamental conditions which govern the growth of the plant, and influence the properties of its fibre. For example, a wide field is open for investigation on such problems as the reaction of the plant to changes of temperature and of water-supply, the causes of boll-shedding; the possibility of breeding cottons that would not easily be hybridized, or those that would be more resistant to disease; the physiological factors which lead to insufficient secondary thickening of the cell wall, and thus cause neppiness. It will readily be recognized how important a bearing the solution of such problems as these has on the question of the world's supply of cotton.

The whole history of science shows that it is impossible to predict what results may emerge from any projected piece of work. Either on the main road, or on entirely unexpected by-paths, vantage-points may be reached from which a clear view is obtained of the country ahead, and though it is seldom that any direct short cut is discoverable, it is often possible to map out with some certainty the route by which alone the objective can be attained, and by means of which, when the traveller is experienced, a successful issue is wellnigh assured.

Out of such work should emerge results which will be of direct benefit to the whole cotton industry. The development in recent years of technological research is a record of the patient investigation of the fundamental scientific principles of a subject which alone has rendered possible the steps by which an industry has achieved its most important advances.

Administration.—It is advocated that instead of a whole-time Director of the Station a local Advisory Committee be appointed to consist of Dr. H. Martin Leake and Mr. W. Nowell, D.I.C., subject to the consent of the necessary authorities being forthcoming. Dr. Leake is Principal of the Imperial College of Tropical Agriculture, and Mr. Nowell is Assistant Director of Agriculture, Trinidad; but we wish to make it clear that our recommendation is that these two gentlemen should be asked to act in the manner indicated in a purely private and individual capacity. The station should be entirely autonomous, and neither the College nor the local Agricultural Department should officially have any voice in the direction of its policy or in the control of its work.

During his tenure of the post of Director of Agriculture of the United Provinces in India Dr. Leake directed and himself carried out much research work on the cotton plant, while he has reported to the Corporation (jointly with Sir John Russell) on the Organization of Agricultural Research in the Sudan, and by himself on the Extension of Cotton Cultivation in the Southern Sudan. Mr. Nowell also is well known for his mycological work on crop diseases and for his expert knowledge of local agricultural conditions, while his advice on the management of crops is valued extremely highly throughout the Colony.

Accessibility of Trinidad.—As regards accessibility, Trinidad can be reached in fourteen to sixteen days from England. There are two direct services, one of which has regular fortnightly sailings. The first-class fare is at present £45. There are also fairly regular sailings, approximately monthly, from India via Durban and Cape Town.

Labour.—There is a population of over 342,000 in Trinidad, about one-third of which consists of East Indian immigrants. Both these and those of African descent are accustomed to agricultural work. Every village has its school, and workers of almost any grade of education can be obtained. Women are largely employed on the land, and in the experimental cotton plots at the College they have also been used quite satisfactorily for such work as counting the number of flowers formed daily and tying up flowers to prevent cross-pollination.

Proximity to the Agricultural College.—We regard it as of paramount importance in maintaining the efficiency of the scientific staff of the station that its members should enjoy the advantage of close contact with people engaged on scientific work beyond the scope of their own immediate interests. It is hardly necessary, therefore, to emphasize the benefits which must follow if the station be placed on a site close to the Imperial College of Tropical Agriculture. It would remove the deadening consequences of isolation so often inevitable in the tropics, with its tendency to narrow the mental outlook and vision of workers, and would provide instead a stimulus by which their ideas are freshened, and without which it is difficult for them to prevent their work from degenerating into routine. It is especially fortunate, therefore, that the land on which the site is situated, which, after full and careful enquiry, we are agreed is that which best fulfils the requirements of the proposed Research Station, offers this advantage of proximity to the College. besides possessing in itself qualities which render it the most suitable site for the purpose in Trinidad.

Furthermore, the advantages ought not to be only one-sided, for, apart from contact between the staffs and the convenience of the College library (and the latter is already a most valuable asset), we hope that the work of the station will interest both staff and students of the College. Such informal co-operation and mutual interest cannot fail to be of value to both bodies, though the main advantage will unquestionably accrue to the station.

Facilities for becoming acquainted with the work of the station will greatly benefit students sent to study at the College, and especially do we look for advantageous results in the cases of men sent there by the Colonial Office or the Corporation, who will later take up appointments in the colonial agricultural departments. Such men will get to know the staff of the Research Station, and will have a personal feeling that they can call on them for advice and assistance later on.

On the other hand, we wish to record our view that it is in the highest degree undesirable that there should be any official administrative connection between the two bodies. Such would almost inevitably lead to friction, and defeat the object we have specially in mind. It is for this reason that we advocate strongly that no movement should be made in the direction of sharing laboratory or other accommodation as between the two bodies, except on the basis of services rendered and paid for. But such a precaution should not in any way preclude either body from utilizing the services of any member of the staff of the other in his individual and personal capacity, if for any reason it should be desirable to do so, provided that it is clearly understood that such service is individual, and that agreed remuneration will be made in respect of it.

Co-Operation with Institutions at Home and Experiment Stations Abroad.—We have already indicated that advantages would, in our opinion, be derived from an organized system of study leave for the staff. Among the institutions at home at which we believe facilities would willingly be given are the laboratories of the British Cotton Industry Research Association. The overlapping in the matter of research work between that body and the Corporation is, in our view, both inevitable and desirable, and it is hoped that close co-operation will be established between them. Probably there would be little difficulty in arranging for a systematic exchange of staff between the Corporation's Station and the botanical department of the Shirley Institute. By such means facilities would be forthcoming for the staff of the latter to test in the field results that have been obtained only in the greenhouse, while, similarly, the Corporation's workers would be able to carry out on some of their material investigations which can more comfortably be made in non-tropical conditions. Moreover, such a scheme would serve to link up the research work done abroad on the growing plant with the problems that present themselves at home in connection with the properties that the fibre should possess for its successful manufacture.

Close touch should also be maintained with the Universities and similar institutions at home, particularly with those to which the Corporation already make a grant for research work on problems that may be referred to them by the Corporation, and for keeping themselves in touch with work on the cotton plant. It is easy to believe that the men appointed by these institutions to specialize on such work would greatly benefit by a few months' work at the Corporation's Station and, in preparing a rough design for the laboratories, space has been allowed for the accommodation of one or two men in excess of the minimum permanent staff suggested in the Report, of which this is a summary. It is hoped that the laboratories of such institutions at home would also be open to members of the Corporation's staff returning to England on study leave.

Cotton Experiment Station, St. Vincent.—Experimental work on cotton, mainly concerned with genetics, has been carried on in St. Vincent for several years. It is recommended that even when the station in Trinidad is established the work in St. Vincent should not be discontinued at all events until the close of the season 1925-26. When, however, work is started in Trinidad, it is suggested that some of the seed which will be planted in St. Vincent in July of this year be also planted in Trinidad at the most appropriate time for the latter island, and that identical experiments should thus be conducted this season simultaneously in both places. The object which it is thus hoped to secure is a knowledge of the effect of the change of place on pure line strains of cotton whose properties have been accurately recorded. It will then be desirable to discontinue the station in St. Vincent, and the same work can be carried on in Trinidad without disturbance of the results, since the factor to be allowed for the transfer from one place to another will have been ascertained from the two simultaneous experiments next season.

Cost.—The net cost of the scheme is estimated to involve a capital expenditure of some £16,000 to £17,000 on the purchase of land and the erection of houses for the staff, and on the building and equipment of laboratories, while the net running costs, after allowing for the sale of produce including cane and some cotton, are calculated to be about £7,000 a year.

The recommendations contained in this Report have been adopted by the Executive Committee, and steps are at once being taken to establish the Research Station in Trinidad.

SOME NOTES ON LARGE ESTATE FARMING IN THE PUNJAB, AND ON THE POSSIBILITY OF ENCOURAGING SIMILAR DEVELOPMENTS IN TROPICAL AFRICA

BY

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PART I

The writer, having had an opportunity of visiting two of the large estates in the Punjab, was much impressed with the value of the work done on them, both for the Agricultural Department and for the cultivators not only on the actual estates, but in the whole irrigated area of the Punjab. In the short time available it was not possible to acquire more than a general knowledge of conditions, and this paper has no pretension to be an exact and critical examination of the Punjab tenant system of *batai*, which, broadly speaking, is one where the tenants cultivate the land and get half the produce, the other half going to the landlord. It is a system which has been long accepted, and is well understood in the Punjab, or Land of the Five Rivers, and is not a recent development arising from irrigation and canal colonies.

The Punjab is particularly well suited to large estate farming with tenant cultivators. During comparatively recent years the Government have opened up, by irrigation, what was formerly almost uninhabited desert land, and therefore have had at their disposal large areas with no inhabitants, no existing system of land tenure, and no vested interests. This land it was necessary to dispose of: some was allotted as a free grant and reward for military or other service, some was leased on special terms mentioned hereafter, but a very large proportion was sold to meet part of the capital expenditure of irrigation, and was acquired by those inhabitants of the Punjab who had the capital and the foresight to realize the possibilities of such land. A considerable portion of the irrigated area thus consists of fairly large holdings cultivated on the tenant system, and consequently the grant of a limited number of comparatively large estates leased on special terms and for specific purposes has in no way dislocated existing conditions.

The development of virgin land under new conditions necessitated much experimental work by the Agricultural Department if the native landholders were to be guided as to the right crops to grow, suitable rotation, amount of water, etc. Experimental agricultural work on a large scale, however, involves additional capital expenditure, and the visible returns on such Government farms are usually small, for which reasons the number and scope of them is bound to be limited. To supplement the work of such establishments as the Agricultural and Research College at Lyallpur, the Government of the Punjab decided to allot to individual concessionaires large grants of land on lease for specific purposes. The following are the areas and the purposes for which they are being worked at present:

Area in Acres.	*Purpose.*
21,000	To produce fodder for the Army.
14,000	Horse breeding.
2,000	Experiments in steam cultivation.
9,000	Cattle breeding.
3,000	Seed production for the Agricultural Department.
7,000	To encourage staple cotton growing, test varieties, establish a buying agency for long staple cotton, etc.

These estates are leased to private individuals, to Government Departments, and in one case to a company. The conditions on which they are held are strictly laid down and scrupulously carried out. Practically all are worked out on the tenant system of *batai*, by which half the water rate, the land revenue, and the taxes is paid by the landlord, the other half being paid by the tenant.

The advantages of such estates to the Government are, as has already been mentioned, that they are practically part of the Agricultural Department with which the lessees co-operate closely and cordially, and that they serve as model farms which farmers can visit in order to see modern and progressive methods of farming and experiments carried out on a field scale. The lessees also act as additional and unofficial channels of communication between the Department and the agriculturists, and, finally, the estates represent a large amount of capital expended for the development of the country without expense or risk to the Government.

The tenants on these estates are far better off than those working on the property of the ordinary landlord, many of whom are absentees, while few take much interest in the cultivation of their land by the tenants. On the special concession estates agricultural methods, rotation, system of watering, etc., are organized and controlled by the lessee, with the result that the yields are higher, and the waste of water and labour is less than elsewhere. The tenants need not sink capital in buying agricultural implements, but can hire the best and most suitable from the landlord, who buys, stores, and maintains them. Inequalities in the nature of the soil are minimized by periodic redistribution of the various rectangles (of 25 acres) so as to ensure that no tenant gets land of poor quality every year. On most estates well-planned villages and roads are made, trees are planted, and wells are sunk by the landlord, and as a rule a small hospital is maintained. Each village is organized and self-contained, and has its own carpenter, blacksmith, potter, carrier, and sweeper, and in many cases its own spinners and weavers.

The crops are sold in bulk, thus ensuring good prices and fair dealing. Above all, the tenants can obtain monetary advances from the landlord on account of their crops, and so are kept out of the hands of the money-lender and usurer, and are independent to a degree which is rare both in India and Africa; they also have a direct share and interest in the development of the estate, and prosper in proportion to its prosperity and success.

It is scarcely necessary to mention that the advantages are not all on the side of the Government and the tenants. During recent years the high prices of agricultural products, and especially of cotton, have ensured for the landlords a considerable reward for the work they have done and the capital they have sunk. It is desirable that this should be so, for the lessees have had to find a large amount of capital, and to take a certain amount of risk in developing their estates. Moreover, unless profits are reasonably high, there is always a possibility that an unscrupulous landlord might supplement them at the expense of his tenants.

The foregoing notes will, it is hoped, be sufficient to explain the general principles of these large estates in the Punjab. To recapitulate, they have been created, so far as the writer is able to judge, for the following reasons:

(*a*) To assist the Government in developing the land.

(*b*) To build up a strong unofficial section of the population which is in close touch with, and to a large degree representative of, the native agriculturists.

(*c*) To assist the Agricultural Department in the solution of problems connected with scientific tropical agriculture.

(*d*) To serve as model farms and object-lessons to native agriculturists, and to level up the agricultural practice of the province.

(*e*) To raise capital for work which a Government cannot normally or conveniently carry out.

(*f*) To trade on a large scale in agricultural produce and to encourage co-operation in trading among landlords and tenants.

(*g*) To better the conditions of the native agriculturists, to ensure that they get a fair return for their labour, and to educate them to work in partnership with a beneficent landlord.

In order to achieve these results it seems essential, firstly, that the organizers and managers of these estates should be the lessees themselves and, if this is not possible, that they should be directly and personally concerned in their success by means of a bonus on results. If such estates were managed by paid agents there would be a danger of weakening the intimate personal touch between landlord and tenant, which is so marked a feature and which contributes so largely to the success of the estates visited by the writer. The second essential is that such estates should be as large as possible, so as to ensure an adequate amount of capital. It is most desirable, when it is possible, to do things on a big scale, especially in Tropical Africa, when, as is subsequently suggested, cultivation is to be combined with a fight against the tsetse fly, which not only infests hundreds of square miles of bush, but is encroaching on areas of country that have hitherto been free of this pest.

PART II

It now remains to consider whether the principles outlined above, or some modification of them, can be applied, and their results obtained in any part of Tropical Africa. To a certain extent they are being tried in the Sudan, where the Government, the native landowners, and the Sudan Plantations Syndicate are in partnership to develop newly irrigated areas. So far as the writer is aware there are few, if any, other such partnerships in Africa. There, agricultural land is usually developed either by individuals, companies, or corporations employing hired labour, or by the natives themselves, guided by administrative and agricultural officers, and assisted in their marketing by European or Indian controlled companies, such as the ginning companies of Uganda, which constitute an essential and integral part of the cotton-growing industry.

There are weak points in both systems. The employment of hired native labour, without encouraging the native to produce for himself, might lead to the relegation of the black man to the position of a "hewer of wood and a drawer of water" for all time. Such a system provides no stimulus for the African to improve himself as a worker, or to work, except temporarily and intermittently. It is this "casualness" which is at present the curse of all African labour, and the cause of its inefficiency. It is a constant anxiety and expense to the employer, owing to frequent changes in personnel and the need for employing unnecessarily large numbers. It often involves the importation from other areas of natives who may be difficult to handle satisfactorily owing to ignorance of their language, habits, and diet, and who themselves may be in a disturbed frame of mind because their own land necessarily remains undeveloped, possibly even uncultivated, and whose women and children, therefore, may suffer for want of food.

On the other hand, where a Protectorate is cultivated by the natives, and where their sole representatives are officials, there is a tendency to "spoil" them, and for the officials to think, so to speak, in terms of that Protectorate only, and for the mental vision to be narrowed and bounded by a limited horizon. Great stress is often laid on the necessity and importance of the natives getting a "fair" monetary price for their agricultural produce. regardless of the moral effect of a possibly violent change from poverty to affluence, which is often the result of a fair price based on the world's market. Such affluence generally leads to the natives either supplying themselves with luxuries, hitherto undreamt of and frequently futile, or resting in idleness for one or two years, as a result of a single easily won harvest. To a certain extent such evils are averted by poor and insufficient cultivation, which results in the land producing a mere tithe of what could be grown. Very few, if any, of the natives put the smallest proportion of what they make back into the land, and, so long as the cultivable area is only partly cleared and it is possible to cultivate fresh ground nearly every year, this poor, extensive system of cultivation does no harm, but it cannot endure. The native population is bound to increase as a result of medical treatment and better sanitation combined with good administration and peace, and a time will come when great tracts that are now thinly inhabited will carry a large population. Intensive cultivation is not an immediate necessity, but a knowledge of how to cultivate intensively is most desirable.

For these reasons, therefore, it is desirable to consider whether there is any middle way between these two systems of developing agricultural land, or rather whether there is any administrative or economic road by which they can be linked together, for both are necessary, and both will endure in spite of their shortcomings. There are great areas in Africa wherein white settlers can thrive and prosper and will require hired labour, and, even if this were not so, there must be in every native reserve a proportion of the population educated to work for hire on public and other works of general importance. It is a counsel of despair to say that a population of small holders will not work for hire, and need not be expected to help in building railways or making roads which pass through their territory, and by which they will benefit. The importation of aliens to carry out such works seems an admission that native cultivation, even though extensive and by no means strenuous, is to be accepted as an excuse for refusing to undertake any other form of work, even though of general public utility.

Apart from this, the world needs more and more of the agricultural products of Africa. An abundant supply of reasonably cheap raw material is one of the world's vital needs at present, and the producer, whether his crop is wheat, cotton, or coffee, or whether he be European, Indian, or African, deserves encouragement.

It is both ignorant and sentimental to brand settlers and companies in Africa as exploiters of the natives because they expect, and in some cases obtain, a relatively large return for their capital. That the natives have been exploited in the past, and will be again in the future, it were futile to deny; but, on the other hand, experience has proved that capital invested in African agriculture may have to lie idle for years before it begins to pay interest, and the white man who faces the many and various risks, the inevitable disappointments, and the certain discomforts of life in Africa deserves a good return for his money.

On the other hand, the native who is induced to grow a crop such as cotton, which gives him a rich return, risks nothing. Even if the crop fails, he will not starve unless his food crops fail also. But he must be encouraged both to produce more than he needs for himself, and to cultivate more skilfully, and thus to do his share for the world, and also to educate and civilize himself. The most effective form of encouragement is a price for his produce which will induce the native to go on growing it, and will enable him to buy some of the luxuries that have hitherto been unobtainable for him. In the opinion of the writer this price need not necessarily mean the maximum world market rates with their periodic and, to the native mind, incomprehensible fluctuations. There are many who hold that the purchase at a fixed rate of the entire cotton crop by the Government is the best solution, at all events in the early stages of the industry, for a native producing area. Obviously, a fixed rate which is high enough to offer inducements for further growing and to make the cultivators prosperous gradually, and low enough to obviate the risk and demoralization of their becoming too rich too quickly, is desirable. Moreover, a fair fixed price would allow the Government, when world prices were high, to form a sinking fund to become available for stabilizing the local price when the world's prices were low, and also to expend money on education, especially agricultural and technical, and on the development of the country generally. Wholesale purchase and a fair price would, in addition, do away with the disadvantages of violent competition, bribery, and corruption, which are only too common features in areas where a valuable crop, such as cotton, is grown by the natives, and where there is free trade for it among the local merchants. The demoralizing effect of such competition is frequently overlooked by those who lay stress on the importance of the natives being well paid for their crops.

But Government trading is bound to be unsatisfactory. It must be restrained by financial regulations, and those responsible are not likely to be able to take the wise risks which are inevitable in trade, but impossible to a treasury. Moreover, such purchase by the Government would increase the official class in a native territory, and this the writer regards as most undesirable, because a population consisting mainly of officials and natives is unlikely to be in the best interests of a Protectorate. It is too like a school, and too free from the bracing effects of criticism.

It is doubtful, therefore, whether Government purchase of a cotton crop would prove either practicable or desirable. If wholesale purchase is accepted as a policy, and it is one with many advantages in the early stages of such an industry as cotton growing, it will probably be best for the Government to employ, as their agents, some reputable company.

The next point for consideration is the education of the natives in better cultivation. It cannot be sufficiently emphasized that education of any sort in Africa will, and indeed ought to, be very slow, and that those who think of African progress must learn to think in terms of fifty and not in terms of five years. At present the African native, generally speaking, is in the stage where he can learn simple things fairly easily, but he forgets just as easily unless he is reminded of them frequently.

Another point to be borne in mind is that most natives are pastoralists rather than agriculturists. Their ambition and their pride is to own large herds of cattle, and even these they do not look after with the smallest degree of science, but allow to increase and multiply and inter-breed, without any consideration of the amount of grazing available for them. The result often is that large numbers die of starvation every year. They know even less about agriculture, and therefore have neither the experience nor the prejudices of the natives of India and Egypt, who have been cultivators for thousands of years.

Simple agriculture must be one of the foundations, if not the principal foundation, on which to build up an educational system in Tropical Africa. Throughout very large areas agriculture is bound to be the main occupation of the natives, and an educational system which aims at raising the status of agriculture and combining with it better pastoral methods is a desirable first step towards civilizing the people. Technical education to improve the quality and increase the number of craftsmen is also essential, and in this direction the schools established by railways are doing most valuable work. Primary education combined with agricultural and technical instruction will make it possible to select the small number who are at present fitted for more advanced training.

With a view to speeding up and continuing the work of village schools and school gardens, as far as agricultural education is concerned, it is suggested that large estates might be leased on special terms, the lessee to act as a beneficent landlord who would organize the agriculture of the estate and market its produce. Such an estate would be a model farm for a considerable area, and might also be a source of pure seed, which is a most urgent need for African cotton-growing areas.

The term " concession " has an evil sound in Africa, and there is no denying that concessions have been given to undesirable characters for thoroughly bad purposes by ignorant and corruptible chiefs. Nowadays, however, British Africa is effectively administered, and such concessions would be practically impossible. To-day any concession would be negotiated with the local administration, and subsequently scrutinized by the Colonial Office, and the difficulty would be to overcome their natural suspicion that the intention of the concessionaire was to make more than a fair profit from the native, and to ensure that he secured a reasonably good chance of getting a fair reward for any pioneer, educational, or agricultural work he was willing to undertake.

PART III

Finally, there is the question as to what, if any, area in Africa might be developed more rapidly and successfully than is the case at present by some such concession as has been outlined in the foregoing pages. It is clear that if such a concession is to be a success, good land with a reasonably large population must be available, and either at the disposal of the local administration or the native chiefs on terms which will not offend or run counter to the existing systems of land tenure, which in Africa are usually clearly defined and jealously upheld by the natives, who are most suspicious regarding any encroachment.

Another point to be remembered is that owing to the difficulty and expense of transport, cotton growers in most parts of Tropical Africa do not get as high a price as do the natives of India for cotton of an inferior quality. In order, therefore, that his tenants may get an adequate price, it is essential that a landlord should have a ginning monopoly over a considerable area, otherwise the profits from such a concession will not be enough to tempt capital in sufficient quantity, or a concessionaire of the right type to undertake the proposition.

In the opinion of the writer a suitable area for such a concession is to be found in that part of the Mandated Territory of Tanganyika, which lies in the Lake Victoria Basin. It may be that the terms of the Mandate render such a scheme impossible, but the writer feels that it is worth giving the reasons for his belief, which are as follows:

1. There is in that area a considerable and industrious population who are partly pastoral and partly agricultural.

2. Much of this area is now useless owing to bush country infested with tsetse fly. This bush country is gradually encroaching on the land of the natives, whose cattle are dying in large numbers from starvation. Tsetse fly must be fought scientifically, systematically, and continuously, and can be fought best on a large scale. A proportion of the bush country that will be cleared as a result of this fight can probably be regarded as Crown land available to grant, lease, or sell.

3. The natives are fully alive to the dangers of tsetse fly. They want to be shown how, and to be helped, to fight it, and they are probably ready to accept a beneficent landlord who would guide their efforts and help them to wage a sustained war against this pest.

4. Bush country that has been cleared is, as a rule, rich land well suited for cultivation.

5. This part of Tanganyika is at present very inaccessible from

Dar-es-Salaam, the headquarters of the administration. Geographically, and by its communications, it is more closely linked with Mombasa than with the former port. It runs the risk, therefore, of being somewhat neglected in the matter of development, in spite of its rich agricultural possibilities, which would well repay capital invested in the area and spent on its development.

6. The Mwanza area appears well adapted for growing cotton on a large scale. It is doubtful whether the best type of seed is being supplied for this area where, even now, cotton of fair quality and over one inch staple is being grown. If the best quality of Uganda cotton seed were grown there, and if the island of Ukerewe were developed as a segregated area to supply seed for the mainland, it seems likely that the cotton of Mwanza and Shinyanga could be improved in quality and increased in quantity.

7. The cotton-growing industry in this area is not an old-established one, and few ginneries have been erected there. It might, therefore, be possible to combine them under a single management and under Government auspices, and to link a ginning combine and an agricultural concession in order to develop the cotton-growing industry on a large scale, and to the benefit of the administration and the natives, as well as to the company which found the capital.

OOMRAS COTTON: THE PROBLEM OF THE SHORT STAPLE

BY

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PART I

RIGHT in the heart of India, covering an area roughly some four hundred miles square, is the tract producing " Oomras " cotton. Its centre is the Central Provinces and Berar. On the west it extends into Khandesh, a portion of the Presidency of Bombay. On the south it includes the Dominions of His Exalted Highness the Nizam of Hyderabad; whilst the northern area producing the so-called Central India oomras. extends into the self-governing States of Gwalior, Indore, and Bhopal.

The word " Oomras " is derived from the name of the town, which was originally the great collecting centre for the cotton of this tract —Amraoti, or phonetically Oomrawuttee, the capital of Berar.

The yield of the oomras crop is rather more than half of the total amount of cotton grown in India.

The yield (400-lb. bales) for the different areas is given below:

	1922-23.	1923-24.
Khandesh	332,000	284,000
Central India	255,000	222,000
Berar	695,000	700,000
Central Provinces	345,000	320,000
Hyderabad Barsi and Nagar	628,000	578,000
Gaorani	451,000	500,000
Oomras, total	2,706,000	2,604,000
India, total yield	5,075,000	5,042,000

The oomras crop to-day is, with the exception of the Hyderabad production, of the shortest and coarsest staple possible. The Hyderabad contribution is, fortunately, amongst the best cottons produced in India, and it seems strange that there should be such a difference between the products of such similar areas in juxtaposition.

The climatic characteristics of the oomras tract are interesting. It is, in the main, an area of plains of not more than 2,000 feet above sea-level. For cotton, irrigation is not practised; indeed, the means of giving it may be said not to exist. The whole of the crop, therefore, is dependent upon the annual monsoon, which sets in towards the end of June, by which date the crop is best planted, and lasts up to October. During this period the rainfall for the tract is some thirty inches, the minimum being in Khandesh; and in Hyderabad, generally, there is rather more.

In June, when the rains have set in and the cotton is sown, the mean day temperature of the tract is about 95° F., and the night temperature some 75° F. From the time of about the first picking, say at the end of October, for the rest of the plants' existence the day temperature is much lower, being from 70° to 80° F. The great difference between day and night temperature in India is striking.

The soil in much of the oomras tract consists of what is known as "black cotton soil." The blackness of this soil would seem to be due to the presence of iron compounds, and not to its being rich in humus. The basis of the soil is a clay, evidenced by its great plasticity on being wetted, and the remarkable tenacity with which it sticks to one's boots in the monsoon season. When the monsoon is over, and the soil begins to dry, great cracks make their appearance on the surface, and extend to considerable depth. These cracks, when they appear early, often cause damage to the cotton crop by rupturing the roots, ending in the premature death of the plant. This black cotton soil is especially typical of Berar, the Central Provinces cotton area, and parts of Hyderabad. The soil of the rest of the oomras tract is somewhat lighter.

The bulk of the cottons grown in the oomras region are of the Asiatic type, but there linger on in almost all cultivators' fields a few plants of the American Upland type, a relic of a one-time attempt to introduce exotics. In all parts except Hyderabad the cotton is almost entirely of the coarsest group of Asiatic cottons, the *Gossypium neglectum* group. The Hyderabad cotton is, in the main, of another and superior Asiatic type, the *Gossypium indicum*. So far as the staple is concerned the "neglectum" group of Indian cottons, from a eugenic (to use a modern term usually applied to human society) point of view, has shown itself up to date incapable of improvement. Many attempts have been made to improve the race by hybridization and selection, but no attempt seems to have been a commercial success. It would appear that the "neglectum" group is a community doomed, for some reason or ancestral vice, always to remain the producers of coarse lint.

The individuals constituting this neglectum group consist of four subspecies: *Gossypium neglectum malvense*, *G. neglectum verum*, *G. neglectum roseum*, and *G. neglectum cutchicum*. The first two have yellow flowers with a red eye, and the last two white flowers with a red eye. *G. n. malvense* and *G. n. cutchicum* have broadly lobed leaves, whilst *G. n. verum* and *G. n. roseum* have narrow lobed leaves. These characters distinguish the four subspecies from one another.

With the exception of the Central India area, which grew originally Malwa cotton (*G. n. malvense*), so named from the Malwa plateau in that area, *G. indicum* was the common cotton of the whole tract. Khandesh, in the time of the Moguls, was a jungle producing wild elephants in abundance, and cotton is perhaps a younger crop there than in the other areas. Khandesh was unfortunate in being one of the centres early selected in the days of the East India Company for the growing of exotic cottons. In 1845 two European planters, having failed to achieve anything in Bengal and Madras, were sent to "the fertile province of Candeish." A more unsuitable region for the purpose it now seems impossible to imagine. In those days meteorological environment was but little studied, and less known. The excessive zeal often displayed in introducing exotic cottons into such provinces, where they never could have finally been other than failures, unfortunately placed almost insurmountable difficulties in the way of cotton improvement in after-years.

The cotton grown in Khandesh at this time was an impure *Gossypium neglectum roseum*. It is supposed by some to have been introduced into Khandesh from the Malwa plateau, but this seems doubtful. Watt, in his "Wild and Cultivated Cotton Plants of the World," suggests it arose as the result of Major Trevor Clarke's hybridizing work. This idea cannot be held, however, by one who has reperformed Clarke's experiments. Another and not improbable idea is that it was introduced from Asiatic Russia, or Asia Minor, through some neighbouring west coast port. It is interesting to note that the Khandesh people called it "varhadi" ("Berar" cotton), but the people of Berar at this time would not own it, and called it "vilayti Khandesh" ("English" or "foreign" Khandesh). This modesty was no doubt partly due to shame, because it was at first largely used as an adulterant of better cottons.

This adulteration of the superior cottons of the Bombay Presidency and Berar led to the passing of a Cotton Frauds Act by the Bombay Government in 1863. The Act as framed proved impossible to work. It was repealed, and replaced by a second Act in 1878. The Act was applied to Berar as well as to the Bombay Presidency (in which is Khandesh). This met with no more success than the first attempt, and was itself repealed in 1882, the Government of India deciding that legislation for the suppression of cotton frauds was not possible. In Khandesh, however, a very energetic Collector, by stern methods, succeeded for a time in practically stopping the cultivation of the old coarse variety, but on his departure the cultivators took to it again because it was a cotton that grew with but little attention to cultivation. The result of it all is that Khandesh to-day grows but little else other than this coarse "roseum" cotton. Khandesh could not exactly be called a region for growing fine cotton. The season is really too short, and the rainfall more often than not too small. The cotton from a part of the Bombay Presidency, on the borders of Hyderabad, south of the geographical area of Khandesh, is also classed as Khandesh Oomras. The Central India oomras consists of two cottons: "roseum" as in Khandesh, and *Gossypium neglectum malvense* or "Malwa" cotton. This Malwa cotton is no doubt, like *G. indicum,* an old indigenous cotton. The "roseum" cotton more especially inhabits the western portion of the Central Provinces, which is known as Nimar, and is included in the Central India area. The Malwa cotton is found in the Malwa plateau to the north of this, and includes several Indian States. The lint of Malwa cotton is superior in staple length to that of roseum, and not quite so harsh, but it is not of such a white colour. In the time of the Moguls, Burhanpur in Nimar was the greatest cotton trade centre in India. Muslins made there went along the valley of the Tapti river to the port of Surat, whence they found their way to Persia, Turkey, Muscovy, Poland, Arabia, and Grand Cairo, as the French traveller, Tavernier, tells us.

The old cotton of Berar was *Gossypium indicum,* or "bani," as it was called in the vernacular. *G. indicum* produces far and away the best lint of any truly Indian cotton. Its staple is strong, silky, and up to 1 inch or even 1⅛ inches in length. It yields on ginning, unfortunately, a comparatively low percentage of lint to seed, that by weight of lint to seed (or the ginning percentage) of a fair sample being about 26 per cent. As will be shown later, this low ginning percentage has, with the system of disposal of cotton usual in much of the oomras tract, been largely the cause of its disappearance. The bolls on ripening do not open fully at their base, and the seed with its lint clings somewhat within the boll. A little extra force is thus required in picking, or it may be that the picker has to make a second pull to get the whole lock of cotton out of the boll. The consequence is that it takes longer to pick than other cottons, and also is not so clean when picked. It contains small pieces of leaf and septum from the boll. Its blow-room loss thus is high, being about 13 per cent. The plant itself is somewhat later ripening than, and not of so hardy a nature as, the cottons of the "neglectum" group. It requires, too, rather more moisture than is necessary for "neglectum" cottons. The large dark yellow flowers, each with a red eye set amongst the broad-lobed leaves, make *G. indicum* a pretty plant when in full flower. In both of these characters it resembles *G. neglectum malvense*. The difference in their lints, however, is a sufficient distinction when one has once seen them. In Berar "bani" has to-day been almost entirely supplanted by the neglectum type. It lingers on to a small but diminishing extent in the neighbouring Central Provinces. It is due to this small amount in the Central Provinces cotton that its value on the Bombay market is always some 20 rupees or more a bale of 400 pounds above the price of Berar oomras. There is still one part of the Central Provinces where some 40,000 acres of almost pure *G. indicum* are grown. This crop is produced in the cold season, being planted about October instead of at the end of June, as is usual for the other cottons.

It was *Gossypium indicum* that made a reputation at one time even on the Liverpool market, under the name of "Hinganghat." Hinganghat is a town in the Central Provinces in the valley of the Wardha river, which district was for long famous for its cotton. It is not an improbable suggestion that it was this Hinganghat cotton from which the wonderful Dacca muslins were made. In olden times cotton from Hinganghat and other parts of the Central Provinces was transported upon the backs of pack bullocks northward to the town of Mirzapur upon the Ganges, down which river it went to the weavers of Bengal. Dacca stands at the mouth of the Ganges, and her weavers hand-spun a yarn of such fineness that it was of 300 count and over. The skill of the Dacca weaver made this possible. There are old stories, which are most probably true, that the fineness was secured by drawing the yarn through holes made for the purpose in the thumb nails. The mode of manufacture eventually became too slow for progressing times. In 1816 the cotton weavers of Bengal exported calicoes to the value of £1,659,994. Ten years later the value of this export was only £285,121. The invention of spinning machinery and the steam-engine brought about this change.

To-day the cotton of Hinganghat has deteriorated, for its ancient

" bani " has been replaced by " roseum." This is what has happened all over Berar and the Central Provinces. Some of the factors that influenced its going were the welcome given to a more hardy plant, its low ginning percentage, its late ripening, and difficult picking.

The cotton that took the place of the " bani " was unfortunately an influx from Khandesh. It consisted at first of a mixture of the old " bani " with the four " neglectums," amongst which the white-flowered *G. neglectum roseum* preponderated. Its coming into Berar was in part due to the vigorous action taken in Khandesh by the Collector to drive it out from there. This cotton came in by way of Berar, and eventually lost its old name of " vilayti " Khandesh (" foreign " Khandesh) for that of " jari," a term which probably means " coarseness." There was consternation at first amongst the authorities concerned with the welfare of the country side. The Resident at the Court of Hyderabad, under which State Berar was then, reported in 1883 to the Government of India that the growth of this coarse cotton should be discouraged, and asked for an advance of money with which to buy up the seed, and for permission to adopt measures similar to those used by the Collector of Khandesh. The Government of India replied that they were not prepared to make any further attempt to control cotton culture, and that it remained to be seen whether the cultivator did not himself know what was best for him to grow.

The civil authorities were not, however, altogether happy about the change that had taken place, and later we find them asking the Government for the advice of a scientific agriculturist upon the matter. This was given in 1888, and the adviser recommended the obtaining of superior cotton seed from outside sources and its distribution. This was done. The scattering of seed attempted at other times, and in other places too, could not be a solution to the problem. The real problem, we shall see later, was not to be met in this way.

Similar advice had been given in 1884 by the Bombay Cotton Trade Association for the improvement of the Khandesh cotton. The then Collector of Khandesh realized the problem when he replied that the cultivator preferred to grow the coarse variety because it was reared with far more ease. The middlemen too, he said, preferred this variety. He asserted that had the latter assisted for one season only by refusing to buy it, it could have been stamped out.

The popular cry was everywhere for this coarse cotton, and thus it became established in Berar.

Favouring factors influencing this were several. It was a crop of mixed types. Now, until it be known which is the most hardy type of such a crop, there is certainly until then, if not always, an insurance value about a mixed crop. If one type fail due to unsuitable season, or other environmental factor, others may not. This, in primitive husbandry, is the reason why two or more totally different crops are often grown together in the same field. It was so in Tudor England; wheat and rye, barley and oats, were grown together with the very same idea.

The coarse cotton, as we have seen that the Collector of Khandesh realized, grew with less trouble than the old finer variety. There was the early ripening and less trouble in picking. By no means an unimportant factor, too, was the higher ginning percentage of the coarse cotton; this, in fact, outweighed all others.

Of the cottons making up this jari mixture any *G. indicum*, with its 1 inch or more staple, yielded the lowest amount of lint on ginning of all, only some 26 per cent. by weight of lint to 74 per cent. of seed. This cotton yields the lowest amount of lint to seed of the five varieties of cottons found amongst oomras. That its ginning percentage could, however, be raised by selection there is good evidence to show. Selection and pure seed, it is claimed, have raised this ratio in the Hyderabad crop to 29 per cent. The *G. n. malvense* and *G. n. verum* lints were the best of the neglectum group; they might in a good sample approach ⅞ inch, but they only ginned at some 28 and 30 per cent. respectively. The *G. n. cutchicum* and *roseum* ginned much higher than the others, 38 and 40 per cent. respectively being their maxima. Commercial samples did not run so high perhaps, but they were always well above the other constituents of the mixture. The lints of both were of the coarsest and shortest, ½ inch being a fair average staple. The spinning capability of these cottons by modern machinery is worthy of notice. *G. indicum* of fair sample by itself will produce a yarn of 20 to 24 counts. Good samples of *G. n. verum* and *G. n. malvense* might give a count of 16, whilst *G. n. roseum* and *G. n. cutchicum* are only capable of yielding a count of about 8 as a maximum.

The great influence played by high ginning percentage and the fact that the highest ginner of all (" roseum ") was the easiest to grow, practically decided the next step. It was the separating out and distribution of pure " roseum " seed.

In this way the whole of Berar and the Central Provinces, to an increasing, but less extent at present in the case of the latter area, became flooded with this cotton.

The Hyderabad oomras (" Barsi and Nagar," and " Gaorani ") illustrate just the reverse condition of affairs to that seen in Berar.

Hyderabad had its battle with the short staple, but decided to keep it out. A system of propaganda, seed distribution, and parental oversight and aid by the State authorities, especially in selling the produce, eventually triumphed. The result is that Hyderabad to-day largely grows *G. indicum*, to the material advantage of its peasantry and the Indian cotton industry.

The oomras cottons produced in Hyderabad fall into two trade descriptions, " Barsi and Nagar " and " Gaorani." The term " Barsi and Nagar " is derived from the railway stations from which the production of the north-west of the State is despatched, Barsi being a town name, and Nagar a contraction for that of another, Ahmadnagar, the latter being on the borders of Hyderabad, but actually in Bombay Presidency. " Barsi and Nagar " cotton is a mixture of the four common " neglectums " and a goodly proportion of bani (*indicum*). It is produced in the area situated roughly some seventy miles east of, and parallel to, the border of the Bombay Presidency. This area runs south to within fifty miles north of the Kistna River. In the north-west corner of Hyderabad State it is no better than the cotton of Khandesh and Berar, owing to the cottons of these latter tracts having crept over their borders. The rest of Hyderabad, except on the Madras borders, produces the " gaorani " (" village ") cotton. It is also sometimes known as " Moglai " cotton (Moglai= Mogul, so called because the State of Hyderabad is a Muhammadan one). This is by far the best of all the oomras, and consists of more or less pure *G. indicum*. It is greatly sought after by Indian mills.

(*To be continued.*)

AN ATTEMPT TO SOLVE SOME OF EAST AFRICA'S CULTIVATION PROBLEMS

BY

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THE rapid development of the tropical African colonies within recent years, the increased income of the native—whether he earns this as wages or by the crops which he produces himself—the scarcity of labour where there has been rapid European settlement, all point to the necessity of making the native more efficient in his cultivation, whether he is tilling his own land or whether he is working for the European farmer.

In many parts of East Africa the only implements used by the native for his own cultivation are the axe and the hoe; the former for hacking down the trees where he makes his garden, and the latter for digging, earthing up, and weeding.

In considering what labour-saving implements can be used, one can divide tropical Africa roughly into two areas. Firstly, the "tsetse fly country," where there can be no cattle or other draught animals; and secondly, those areas where cattle can be kept. Implements, therefore, can be divided into two classes: hand implements or implements for manual draught, and implements drawn by draught animals. The essentials for such implements in both cases, however, are the same. These must be cheap, efficient, easy to handle, and easy to repair.

The following description of the efforts made at the Makwapala Cotton Station to solve these problems may be of interest. Very little claim to originality in these implements can be made. Most of them have been evolved centuries ago, and are still in use throughout India. They have merely been modified for use under different conditions.

HAND IMPLEMENTS AND IMPLEMENTS FOR MANUAL DRAUGHT.

For preparatory cultivation it is difficult to suggest any alternative to the native hoes. These vary in shape and size according to local custom, though probably this is governed to some extent by local soil conditions. One great defect in these is that they are too light in weight—very much lighter than the same type of implement used in India. This means a waste of muscular energy, for this has to take the place of gravity in driving the blade into the ground. It is very difficult to get the African native, however, to realize that the heavier hoe means less work for himself. It is quite possible that if he could buy the two for the same price, he would get the heavier one as better value for his money, and that in time he would see its value in saving work.

Implements for Sowing.—The initial improvement for efficiency is to get the crop sown in lines. In Nyasaland this practice is universally adopted by European farmers, and one now occasionally sees native gardens sown or planted in the same way, copying the European system. This in itself shows that the native realizes that there are advantages in this. The existing method adopted by Europeans of making lines is, however, tedious and extravagant of labour. It consists in marking out the lines with pegs, and making parallel ridges, high or low according to the fancy of the farmer, which, when the rains come, persist sufficiently to indicate the line along which the seed is to be dibbled. Besides the cost of making such ridges, which have all to be made with the hoe where there are no cattle, this preparatory ridging makes it very difficult to do weeding if, as often happens, the weeds come up and choke the ground before sowing can commence. It is much more satisfactory to be able to mark the lines immediately before sowing. This means that one can start the crop on a clean seed bed. A simple marker can be made by inserting two hard wood tines into a beam of wood at the required distance apart and at a suitable angle, a guiding handle and a draught pole being attached to the beam. Such a marker is shown at work in the accompanying illustration (Fig. 1). Across the draught pole of this is tied a light wooden bar, to which a hanging weight is attached at either end. The distance between the attachments of these two weights is three times the distance between the tines. Thus, when two fresh furrows are to be made, one of the weights lies in the last furrow made when the man pulling the marker is in the centre of his new line of draught. This weight merely acts as guide to the man at the guiding handle. In addition it is necessary, when dealing with African labour, to have some further guide as to direction, and this can be done by setting up sighting poles at suitable intervals along the new line of draught. These sighting poles should be one and a half times the distance between two rows in length. The men who work the marker change these. When they reach a sighting pole the man at the guiding handle takes up the pole and measures off from the last furrow made

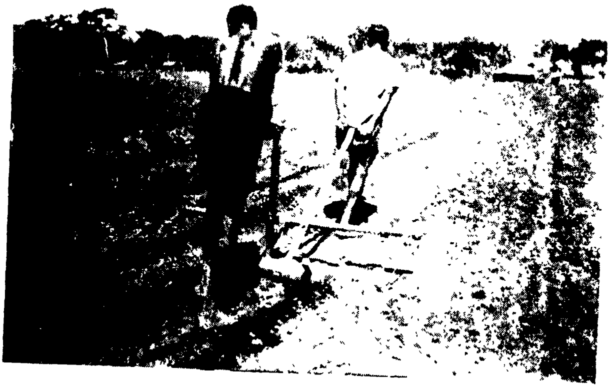

FIG. 1.—MARKER

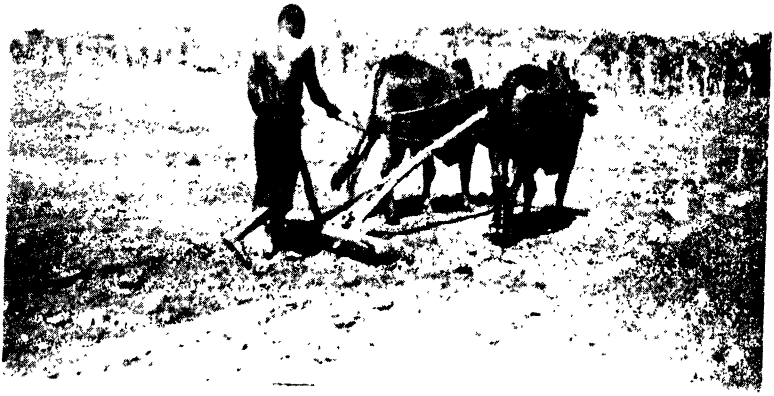

FIG. 2.—A BLADE HOE AT WORK COVERING SEED AFTER DRILLING

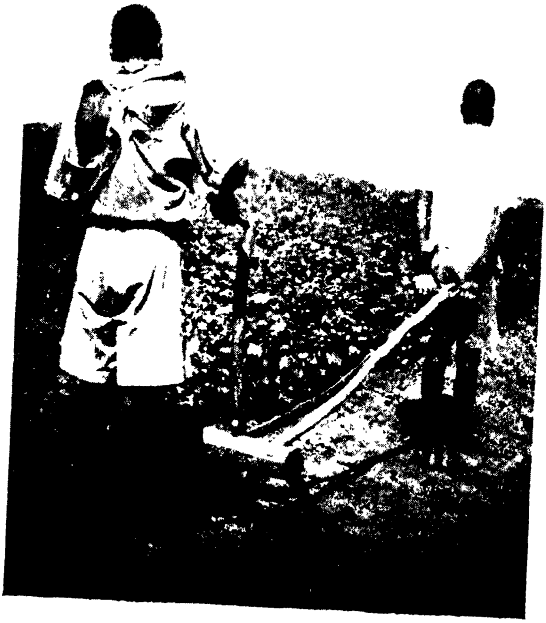

FIG. 3. BLADE HOE.

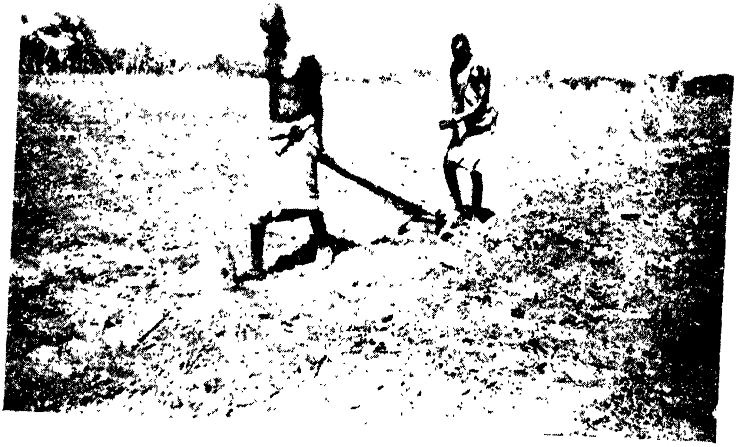

FIG. 4 —A MANUAL DRAUGHT BLADE HOE.

and puts it up again, so that on the return trip the poles are in line for the man at the draught pole to walk along. After a very short time the men get quite used to working this marker, and manage to make very fairly straight lines. The marker is followed by two men, each supplied with a tin tube with a funnel at the top. The tube should be about 3½ feet in length. This is hung round the sower's neck with a rope in such a way that the end of the tube is in the furrow when the slope of the tube is 45 degrees. The sower then takes the seed from his cloth, and feeds it into the funnel, and the seed runs down the tube into the furrow. The other hand is used to press lightly on the tube, so as to steady the end in the furrow. To cover the seed a bush harrow made of thorn branches can be used in the case of small seed, while for larger seed a blade hoe can be used (Fig. 2). This latter implement is described later. The native very quickly picks up this method of sowing, and can sow quite an even and thin seeding. Of course, when sowing a crop like cotton, it is necessary to dress the seed so as to eliminate the clinging action of the fuzz. If delinted seed can be obtained, so much the better, but failing this it can be rubbed with cow-dung or a paste made with maize flour or similar starchy material. This method of sowing is merely a modification of the Indian bamboo seed drill, the difference being that the marker and seeder are separate.

Implements for After-Cultivation.—It is essential in tropical farming to keep weeds in check and to prevent their seeding on the land. Therefore, intercultivation should commence as soon as possible after sowing—in fact, it is often necessary to remove weeds before sowing so as to give the crop the best possible start. Weed seeds, it must be remembered, come up quite as quickly as, if not more so than, the crop sown, and their growth, if not checked, is frequently much more rapid than that of the latter. If the season is favourable, the blade hoe can be used for intercultivation between the rows. This cuts the soil about an inch below the surface and will, on a bright day kill all young weeds in its course. The blade hoe is made in a similar manner to the marker. It consists of an octagonal beam of wood. On one face of this octagon two strong wooden pins are let in to take the blade. On the adjoining face the draught pole is let in, the pole being split for about 3 feet, and the split ends being inserted into two holes in the beam. On the next face but one the guiding handle is let in. A blade 15 inches in length is suitable for manual draught (Fig. 3). Such an implement is seen at work in the accompanying illustration (Fig. 4). The blade hoe, however, has its limitations. It cannot be worked where weeds have become established, as these catch on and choke the blade, and it cannot work when the land is really wet, or when, after having been beaten down by rain, it has been allowed to bake hard in the sun. If, however, a little judgment is used, and the work done at exactly the right time, it is surprising what great use can be made of this implement. Two men working this implement between cotton rows set 4 feet apart can cover from two to two and a half acres a day, taking two trips to each row. In favourable seasons, this implement will do all the work of inter-cultivation required, but if there is continuous rain after sowing it may become necessary to loosen up the soil and weed the crop with the hand hoe. The only other operation required for most crops is thinning in the line where seeding has been too heavy, and weeding by hand along the line. The use of the blade hoe is of extreme importance in forming a soil mulch rapidly. This is specially the case in Africa, where the rains usually cease suddenly, and the ensuing weather is very dry. It is essential with a long duration crop like cotton to retain as much moisture in the ground as possible at this season of the year in order to mature the crop.

Cultivation with the Aid of Cattle.

Tropical Africa—at any rate the East Coast—has been largely influenced by the agricultural practice of South Africa. There the tendency has always been to use the big team for all preparatory cultivation.

On the Makwapala Cotton Station rather a different attitude towards draught cattle has been adopted from the usual African one. In the first place the animals are properly housed. They are stall fed, being given concentrated food and salt, besides straw and rough fodder. The fodder has consisted of maize straw which, since it was cut on the green side, has all its leaf on it. The animals are groomed every day, which makes them much easier to handle, and much more tractable when in the yoke. In fact, they are treated as draught animals. They are always in good hard condition, and can always do a good day's work. Secondly, when worked in the field, they are always worked in single pairs, and never in teams. They are never led, and one man drives his pair and guides his implement at the same time. A led bullock, like a led horse, always moves slowly. The men are not allowed a whip, and only use a thin bamboo. This method of working cattle has many advantages, the main ones being that there is no heavy expenditure on implements, and the work can be done with much greater expedition.

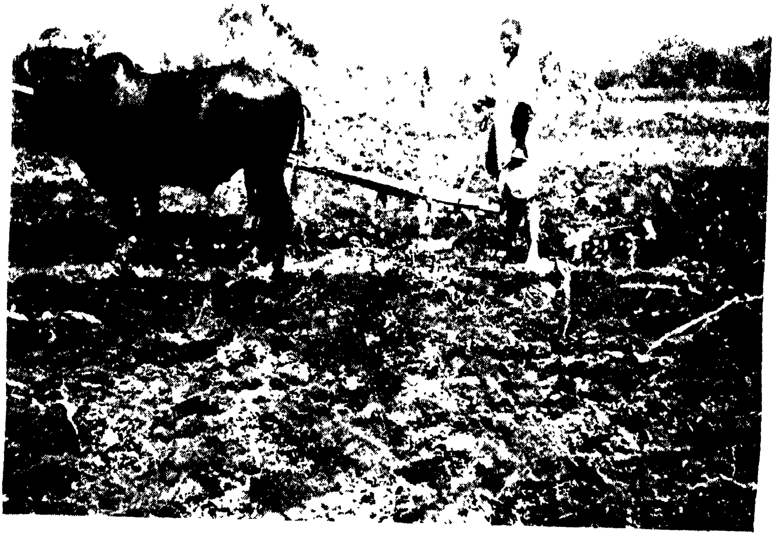

FIG. 5.—A SMALL PLOUGH

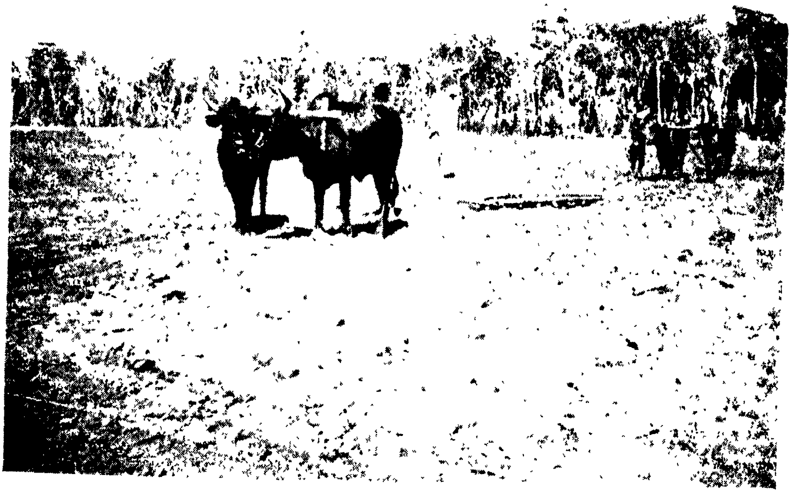

FIG. 6.—THE "LADDER"

Preparatory Cultivation.—If cattle are to be worked as single pairs it of necessity means that the plough to be used must be of light draught, and if a light plough (Fig. 5) is to do good work it is essential that the ploughing should be done while there is still sufficient moisture in the ground after the previous crop has been harvested. This is usually possible if the intercultivation of the previous crop has been properly attended to and a soil mulch has been maintained to retain moisture in the ground. Ploughing after maize this last season presented no difficulties. The maize was sown at the beginning of December, and the harvest commenced at the end of March, by which time the grain was hard, but the straw was still fairly green. The crop was cut close to the ground without removing the cob, and the stalks were stooked along the roads adjoining the fields, where they were left to thoroughly dry out. As soon as the crop was removed from the field the ploughs started in. The previous cover of the maize crop had kept the soil sufficiently moist to allow of this. Weeds had also been kept in check by intercultivation and by the shade of the maize crop, and these were turned in before they could seed. The area ploughed was fifty-five acres, and this was finished in twenty-nine working days, using sometimes four and sometimes five ploughs. The ploughing would have been finished sooner but for frequent stoppages on account of hidden stumps and roots. These had been left in the ground prior to planting the maize when the land was stumped, and the timber on it felled. Also several points and shares were broken by the same cause. These are, however, defects which will remedy themselves as the land gets broken in. The plough used was Ransomes, Sims, and Jeffries' " Jat " plough. The plough is attached to the yoke by a draught pole which gives a rigid draught. The plough is guided by a single stilt, which is almost vertical with the ground when the plough is at work. This is a great advantage as the ploughman is close up to his bullocks when at work, and has much better control over them. There is no doubt that the " Jat " plough can be improved upon. One of the weak points about it is that the share has to receive any jar which the point receives and is apt to break. This year we are trying a modification of Ransomes' " Mysore " plough, which is furnished with a steel bar point attached to the body of the plough instead of to the share.

Even after a long duration crop like cotton, which was not removed from the ground till three months after the dry weather had set in, ploughing with these light ploughs was quite successful. This, however, was only possible because a soil mulch had been maintained in the cotton crop.

The main advantage, besides the low cost of these ploughs, in this method of ploughing is the rapidity with which the ground can be covered. I do not know of any heavy plough where the same acreage could have been ploughed in the same time and when the same number of cattle were employed. Expedition is everything in this sort of work. It means that the plough fallow is started at the earliest opportunity. All weeds have been turned in before they can seed, which means a great saving in the cultivation of future crops on the same land.

A cross ploughing was given to all this land later on in the dry season, but since the land was already broken up by the first ploughing, this presented no difficulties.

After the cross ploughing was completed the land was cultivated. The cultivator used was the heavy blade cultivator or "bakhar" of the Central Provinces of India. This consists of a heavy iron blade of some 18 inches wide, set into a beam of wood, making an angle of 45 degrees with a double draught pole. The cutting edge of this is curved slightly inwards to steady it in the soil. This implement works to a depth of some 5 inches, and brings all the clods up to the surface, at the same time settling a fine tilth below the clods which forms an excellent seed bed. The implement was made by a local carpenter and blacksmith, and its cost was merely their wages and the cost of the iron for the blade, and for its attachment to the beam.

With the advent of the first rains the clods brought up by the "bakhar" were softened sufficiently to be broken down by using a "ladder" (Fig. 6). This consists of two straight poles laid parallel on the ground to which cross rungs some 2 feet long are nailed. A chain is attached to the second or third rung and fastened to the yoke. The "ladder" is thus drawn along the ground diagonally, and the clods are broken down between the rungs. The implement can be weighted down with stones if it is found to be too light. After using this the land is then ready for sowing.

So far it has not been possible to experiment with bullock-drawn implements for seeding and after-cultivation, as the land available still contains too many roots to render this feasible.

The great advantage of all the implements described is that they are cheap to make or buy, cheap to work, and easy to repair; and for native cultivation a single pair of cattle is all that is required to be kept.

INSECT PESTS AND COTTON DEVELOPMENT

BY

PROFESSOR H. A. BALLOU.

COTTON as a crop has always been very subject to the attacks of insect pests. All parts of this plant are attacked, some insects affecting the life and health of the plant by injuring or destroying leaf, stem, or root, and others directly injuring the prospects of the crop by feeding on flowers and fruits. Of these two kinds of attack, the second appears to be the more serious, because of the direct effect on that part ot the plant producing the marketable product, and also because insects which can penetrate into a mass of tissue, such as the developing boll, are hidden from view and out of reach of poisons. Anything which adversely affects the health of the plant also exerts an influence on its ability to produce a crop, and therefore insects affecting the leaf, stem, and root are important and often serious pests.

So far as past experience indicates, however, it would appear that the insects which will influence the development of the cotton growing industry in new localities in the near future are those which attack the bolls, and of these, the cotton stainers and plant bugs are probably the most important.

At the present time, the three great insect pests of cotton are the Mexican Boll Weevil, the Pink Boll Worm, and the Cotton Stainers.

The Mexican Boll Weevil owes its reputation to its persistent invasion of the American cotton fields; the Pink Boll Worm to its sudden leap into prominence and its menace to cotton growing throughout the world; while Cotton Stainers by their insidious attacks and their association with the organisms causing internal boll disease are of much greater importance than is generally recognized.

The Mexican Boll Weevil (*Anthonomus grandis*) is eminently an American pest. Crossing the border from Mexico into Texas in the early nineties of the last century, it has been for nearly thirty-five years steadily and irresistibly invading the cotton belt, until now the entire area of more than 700,000 square miles in which the 30,000,000 acres of United States cotton cultivation are located is infested with this pest, which has caused, and is still causing, great losses to the cotton grower and to every branch of the cotton industry.

The farmer loses his crop, the manufacturer feels the shortage of cotton, and the consumer is affected by the increased prices.

The United States farmer has not abandoned cotton cultivation as a result of the ravages of this pest, but he has been able to continue only because the interests involved are so large. The world's manufacturers and consumers cannot get along without the American cotton, and as the price of cotton depends on the American crop, the effect of boll weevil attack has been to increase the price as well as to reduce the output, the farmer selling his smaller crop at a higher rate. If the boll weevil had invaded a district where cotton growing was in a state of development, where the amount of the crop produced was too small to affect the world's markets materially, and where the agricultural population had not learned to depend on cotton as a crop, it is safe to say that such considerable losses in yield would have resulted in the industry being abandoned.

For many years most careful study of the boll weevil problem yielded no indication of any adequate means of control. The natural enemies, predaceous and parasitic, of the boll weevil were not effective, and none of the insecticides tried gave satisfactory results in poisoning the weevils, while the grubs feeding within the bolls were beyond the reach of poisons. Recently calcium arsenate applied as a dust by means of powerful blowers has been found effective in giving some protection to the growing crop.

The Pink Boll Worm (*Platyedra gossypiella*) is becoming the most cosmopolitan of all the various pests of cotton. It was known to occur on cotton in India for many years before it was recognized as a major pest. It was introduced into Egypt about 1910, where it very shortly became the most serious insect pest of the cotton crop.

At the present time it occurs in almost every important cotton-growing locality in the world; it is established in Mexico, South America, the West Indies, in most parts of Africa, in certain sections of Australia, in India, Ceylon, China, the Hawaiian Islands, and Fiji.

The Pink Boll Worm is difficult of control by any direct methods. The tiny caterpillar penetrates into the boll as soon as it is hatched, and during the whole of the time it is feeding inside the seed in the boll. Its natural enemies are not effective in controlling it, and so far the use of poisons has not produced any satisfactory results.

At the end of the crop season many caterpillars remain in the seed. These are full-grown and capable of existing without feeding, in a resting condition, for periods ranging from a few weeks to many months. It is in this condition that the insect lives over the winter, or from one cotton season to another, and in this condition also that it is transported from one country to another.

The thorough cleaning up of all old cotton, and the treatment of the seed by heat or fumigation, to kill the insects resting in the seed, are the most effective means of dealing with this pest.

Cotton stainers are indigenous to all warm countries, and are actual or potential pests of cotton in nearly every locality where cotton is or may be grown. They are plant-sucking bugs which attack the bolls. The staining of the lint is due to the action of the internal boll disease, which is caused by certain fungoid or bacterial organisms which invade developing bolls when these are attacked by stainers.

The cotton stainers are usually distinguished by a general reddish colour, from which they derive a name common in many places, the Cotton Red Bug. The young insects are of a bright red colour. Other plant bugs—green bugs—attack cotton bolls in many localities, with the same effect of producing an internal boll disease.

The amount of stained lint is often an index of the severity of stainer attack, but in many instances of severe manifestation very large numbers of bolls are completely destroyed, and the crop greatly reduced. The percentage of stained cotton ginned only shows the injured lint in the crop that has been reaped, and does not represent the portion of the crop that was totally destroyed.

Let us now consider how these insects, and others like them, may be expected to manifest themselves in connection with the development of new cotton areas.

The boll weevil is an American insect. Even after more than thirty years' activity it has not become established in other countries. The other species of the genus, which attack cotton in South America, have not attained to the status of pests of the first order. In only one locality do the records show that a weevil of similar habits—that is to say, a boll weevil—has appeared as a serious pest of cotton. This occurrence has been in the Philippine Islands, where a weevil (*Amorphoidea lata*) is reported to be a serious pest of cotton bolls. In all other regions where trials in the growing of cotton have been made, and careful observations on the insect pest have been carried on, boll weevils have not appeared. These trials have been so extensive and under such varying conditions that it would appear that the boll weevil problem is not likely to arise in the new localities where this crop may be experimented with.

The boll worms, however, present a different case. Of one kind or another they occur at present in all cotton-growing localities, and many other caterpillars not now known as cotton pests may be expected to attack this crop when it is grown on a large area, particularly if the cotton lands are obtained by cutting down forest and bush, thereby greatly reducing the native food plants, and planting in their stead such an attractive plant as cotton.

The American Boll Worm (*Heliothis obsoleta*) has been for many years a serious pest in the United States of America, and it is found in most parts of the world where agricultural crops are grown. Its food plants are many and cover a wide range, and it has a great variety of common names, many of them indicating the plants which it attacks, such as Cotton Boll Worm, Corn Earworm, Tomato Worm, Tobacco Bud Worm, and many others. It is extensively and effectively parasitized, and on this account its occurrence is sporadic. It occurs at times in some abundance, and then disappears for a while.

The Egyptian Boll Worm (*Earias insulana*), which occurs in many parts of Africa, in India, Ceylon, and other Eastern localities, is a pest of long standing.

The Sudan, or Red Boll Worm (*Diparopsis castanea*), has proved to be a very serious pest in some districts of Nyasaland, where cotton has been tried on fairly large areas. In Australia a boll worm (*Dichocrocis punctiferalis*), well known as a pest of other crops, has attacked cotton to some extent, and even in Trinidad, where there is no cultivation of cotton, a boll worm attacks the bolls of wild or native cotton, and may prove to be a pest of importance if, and when, cotton is cultivated year after year on large areas.

In the case of cotton stainers another aspect is presented. These insects occur in all localities where cotton is grown or is likely to be grown, and in most instances are indigenous there. Their natural food is cotton and related plants of the order Malvaceæ. Their attacks on the young bolls are followed by the development of the internal boll disease, which may completely destroy the boll and its contents, or injure the lint so that it can only be sold as stained.

The organisms which cause internal boll disease have been recorded from several widely separated localities, and will probably be found over as great a geographical range as that covered by the cotton stainers. There is every likelihood that the stainers will appear as pests of cotton wherever cotton is grown. They may not be so serious as to attract much attention for several seasons, but, on the other hand, they may quickly become abundant and destructive.

The development of a cotton-growing industry in any new locality will have to take into account the prospect of attacks by boll worms and stainers, in addition to the many pests which may affect the other parts of the plant. Some of the latter are important—caterpillars, grasshoppers, thrips, and aphis on the leaves, scale insects and mealy bugs on the stem, borers in the stem, and grubs in the soil at the roots of the plant. Any or all of these may appear as pests, but the insects which will probably determine the fate of the new cotton industry will be the boll worms—the Pink Boll Worm, the Sudan Boll Worm, or possibly some unknown species, and the cotton stainers.

One of the first essentials in developing a new area for cotton growing is a thorough survey by entomologists to provide a record of the indigenous insects and their wild food plants, and when planting begins this should be followed by careful watching of the growing plants for the first possible records of insects appearing on them. If this course is followed, methods for dealing with most insects will be devised, and if pests which cannot be controlled appear in any locality, it will be of interest and great economic value to be aware of them at the earliest possible moment.

The experience gained in the West Indies in the establishment of the Sea Island cotton industry during the past twenty years may be of interest in this connection. The planters, the local Departments of Agriculture, and the Imperial Department of Agriculture, working together in close co-operation, developed the cotton industry as a community interest in each of the islands where this work was started. This resulted in uniformity in (*a*) the kind of seed planted; (*b*) the kind of preparation and cultivation; (*c*) the control of pests; (*d*) the establishment of the close season; and (*e*) the legislation necessary to deal with certain insect pests and plant diseases.

The close season has played a most important part in the work in the West Indies. It is a period of one or two months at the end of the crop season, during which there should be no cotton growing in the field in any locality. Usually one month serves as a close season for an island.

Before the first day of the close season all cotton plants should be pulled or cut, and either buried or burned, and no planting of seed for the next crop should be made. During the close season all cotton should be ginned, all scattered seed and fallen bolls cleaned up in the fields and in and about the store-houses and all buildings and places where cotton has been handled or stored during the season.

When the first plantings of cotton were made, nothing was known about the insect pests which might make their appearance in the fields. It was fully expected that some form of leaf-eating caterpillar would attack the cotton, but when the Cotton Worm (*Alabama argillacea*) arrived in enormous numbers in the first season of planting on an estate scale, the amount of insecticide available was quite inadequate. In the following season large stocks of Paris Green and London Purple were laid in in advance, and from that time the cotton worm has been under control.

The Leaf Blister Mite (*Eriophyes gossypii*) suddenly appeared and destroyed considerable areas of growing cotton. This was a new pest, unlike anything that had been recorded as attacking cotton, and up to the present it has not appeared anywhere else as a cotton pest. This new and alarming pest was given various treatments, until it was found that thorough cleaning up at the end of each crop season was an effective control measure.

The Flower Bud Maggot (*Contarinia gossypii*) was a serious pest in only one island, and the effects of its attacks were noticed at certain seasons only. The attacked flower buds dropped from the plants, and in certain instances all the flower buds were destroyed over long periods. The control measures were found to consist of planting at such a season that the bolls were formed before the time for the flower bud maggot attack to commence.

The Black Scale (*Saissetia nigra*), which completely destroyed entire fields of cotton, was in time partially controlled by its parasites. The practice of thorough cleaning up after the crop was found to be effective in completing the control of this pest.

The cotton stainers were present in all the West Indian islands except Barbados, where this pest has never appeared. In St. Vincent the cotton stainer (*Dysdercus delauneyi*) persistently recurred year after year as a serious pest, and the losses which resulted from its attacks were so great that the very existence of the cotton industry was threatened.

The Northern Islands stainer (*Dysdercus andreæ*) varied in the time of its appearance, and there was a lack of uniformity in the relation between the abundance of the insect and the amount of damage done.

When, in 1916, the relation between the feeding of the stainer and the incidence of internal boll disease was definitely established, and an account given of the specific organisms concerned in the production of the disease, the real damage done by the insects was recognized.

In St. Vincent, where a large part of the crop was being lost each year from stainer attack, and a large proportion of the crop reaped consisted of stained cotton of very low value, it was plain that more vigorous efforts must be made to control the pest.

In addition to the cleaning up methods and the close season, a campaign for the destruction of wild food plants of the insect was instituted. This measure was very successful, the numbers of the stainers being greatly reduced, and the amount of the crop increased, while the proportion of stained cotton was very much reduced.

Then, in 1920, the Pink Boll Worm arrived in the West Indies. It had been feared that if and when this greatly dreaded pest should appear, the growing of cotton would become impossible. Thanks to the knowledge on the part of the cotton growers of the value of the clean-up policy and of the close season, no time was lost in adopting the necessary measures for a fairly successful control of this pest. The first bearing of the crop came through without much loss. The second bearing, however, was lost. In some districts, where the seasons were unfavourable, it has been found impossible to grow cotton, since it is not possible to plant at the proper time. With favourable weather for early planting and for continuous and vigorous growth it has been possible to produce reasonably good crops, even since the Pink Boll Worm became well established.

In the case of new developments in cotton growing the probability of insect attacks must be borne in mind. Careful observation of the insects of the neighbourhood likely to attack cotton and of the insects which come to the cotton fields should make it possible to prepare for serious outbreaks of pests and to institute the necessary measures for the protection of the crop. A knowledge of food plants and habits of the insects is essential, and for this purpose the presence of an entomologist is necessary. If a pest which cannot be controlled appears in any locality, it is better that the difficulties should be recognized as early as possible before large sums have been expended in cultivation. Many pests which are very troublesome when they first manifest themselves gradually become less and less so, as has been the case in the West Indies, since cotton growers have paid more and more attention to the cleaning up or sanitation of fields and farm premises. The natural enemies tend to increase as the pest becomes more abundant, and this helps to keep its numbers down.

To be forewarned is to be forearmed. The greatest possible knowledge of the possible or probable insect difficulties, together with an understanding of what can be done by way of control under the peculiar conditions of the locality, provide the best insurance against failure. Knowledge and organization have made it possible to establish cotton-growing as an industry in the face of unknown and serious pests, and they will always be essential to success.

Received July 31, 1925.

THE
BREEDING OF JASSID-RESISTANT COTTONS

REPORT FOR THE SEASON 1924-25

BY
F. R. PARNELL.
Plant Breeder, Union of South Africa.

INTRODUCTORY NOTE BY MR. S. MILLIGAN.—In my proposals for the staff to be employed by the Empire Cotton Growing Corporation, submitted to the Government of the Union of South Africa, I suggested the recruitment of two entomologists to be employed in the Division of Entomology, one chemist to be similarly placed in the Chemical Division, and that to Mr. F. R. Parnell, who had already been recruited by the Corporation to work directly under me, should be allotted the duties of cotton-breeding for the low veld area. It was felt that the problems to be faced in breeding cotton for the low and middle veld areas presented a distinct cleavage, owing to the existence of the jassid problem in the former, and the necessity of breeding for early maturity in the latter. Reports of the work carried out by the Corporation's officers in the Entomological and Chemistry Divisions will be presented in due course by their respective heads. I have asked Mr. Parnell to write a short note on his work and observations up to nearly the end of the 1924-25 cotton season in South Africa, with special reference to jassid attacks, in view of the anxiety of cotton growers on the low veld regarding this pest. I also wish to keep the Corporation fully informed of the progress made in breeding jassid-resisting plants, as it is of importance in other parts of Africa.

It is hoped that publication of Mr. Parnell's note may go a long way towards reassuring public opinion that the ravages of the jassid can be largely countered by plant selection and breeding.

The main feature of the note is the clear demonstration, through growing the progeny of single plants side by side, of the inheritance of jassid-resisting qualities and the consequent possibilities of breeding resistant types. Further, the Cambodia selection from India has been entirely jassid proof, while other types varied from " high resistance " to jassid in the case of Z.1. (a new type found in a large number of single plants selected for me at random in Zululand last year) to "no resistance at all" in the case of Watts' Long Staple. The Cambodia type, however, requires acclimatization, as in this its first year in South Africa it tended to "run wild," and could not be multiplied for immediate distribution on account of its habit. It is fortunate, however, that the type Z.1. shows, in addition to high jassid-resistance, other excellent qualities, and it is proposed to propagate further the seed of this variety. It will, of course, be tested next year to check this year's results, also some of the seed has been self-fertilized for the sake of further improvement, but, in view of the urgency of producing "jassid-resisting" seed in larger quantities at the earliest moment, the remaining seed will be multiplied in the most economical manner possible. If, therefore, the strain turns out all right in next year's trials, no time will have been lost, and it will be possible to plant a few hundred acres of it in 1926. Given good seasons, the year 1927 should see large quantities of Z.1. available for distribution. Meanwhile, if all goes well, other and possibly better strains will be forthcoming, and there should be little difficulty in fitting these into the various low veld cotton-growing areas. Mr. Parnell gives reasons for abandoning mass selection as a rapid means of giving some temporary relief, but, at any rate, even mass selection would not have given us any bulk of seed before 1927, and the produce from Z.1. will, of course, be infinitely superior to anything we could have obtained by that means.

It will be seen that Mr. Parnell is of opinion that damage by jassid is due, partly at least, to a toxic effect caused by the insect, and that resistance consists not only in some degree of immunity from attack, but is also due to a constitutional power of tolerating the action of the pest. He further states that "resistant" plants give the impression of being specially tough and hardy, and capable of withstanding all vicissitudes better than the average plant. If these observations are confirmed they are obviously of the greatest importance. It will also be observed that although Z.1. was found in a field of Zululand Hybrid, resistant plants have been found in other varieties, thus widening, to a very considerable extent, the choice of selection. Mr. Parnell has already about 150 plants selected mainly from Bancroft and Zululand Hybrid, all showing jassid resistance, and with lint about 1¼ inches, and this year's experience indicates that a considerable number of these will be found to breed true to jassid-resistance.

Whether, in view of the promising nature of this year's results, it will be necessary to continue purely entomological work on jassid is for decision by the Division of Entomology. Under the most favourable circumstances two years at least will elapse before pure seed of a jassid-resistant strain can be issued in large quantities, and it may thus be worth while to continue work on dusting and spraying as a specific against attack. Meanwhile, however, the bollworm problem presses for some solution to mitigate, at any rate, the earlier attacks in the middle veld area, where early infestations make the crop later. The low veld area will suffer less through early bollworm attacks if the jassid can be overcome, as the main damage in this case is due to the combination of the two pests.

THE BREEDING OF JASSID-RESISTANT COTTONS IN SOUTH AFRICA

The desirability of improving the varieties of cotton grown in the Union has been increasingly obvious to all concerned in the industry for several years, and it was partly for work in this direction that the help of the Empire Cotton Growing Corporation was solicited by the South African Government. Mr. Milligan, after his arrival in June, 1924, discussed the situation with officers of the Tobacco and Cotton Division, and it was decided that the breeding work already in progress at Rustenburg should be applied especially to the middle veld areas, and that the Corporation's Plant Breeder should work for the low veld cotton belt, which extends through the Eastern Transvaal into Zululand. It is with the latter area that this note is concerned.

Work was started at Barberton at the beginning of the 1924-25 season on a piece of land set apart by the prison authorities, and on special plots very kindly grown by Messrs. Andrews and Spear on their own farms. The crop grown comprised the following:

1. A collection of the chief varieties under cultivation in the Union.
2. Several varieties imported from the United States of America and one from India.
3. Several strains of Improved Bancroft and Meade raised by officers of the Tobacco and Cotton Division.
4. About fifty single plant selections out of Zululand Hybrid from Messrs. A. P. Rouillard and Cross Estates, Ltd.

Thanks are due to a number of gentlemen who supplied the seed, and helped to make the whole collection a good one.

The season is not yet finished, and quantitative results have not been obtained, but certain definite conclusions may be drawn from the experience gained up to date.

It was originally intended to work mainly on single plant selections, but also, if possible, to make mass selections in the two varieties most largely grown in the Union—viz., Zululand Hybrid and Improved Bancroft—in order to secure some immediate improvement. With both varieties, however, though the seed planted was the best obtainable, an examination of the crop at the beginning of the flowering period showed enormous variation, no dominant type existing, but good, bad, and indifferent plants being hopelessly mixed. The good plants covered a wide range of types, of which many appeared capable of giving sound economic strains if separated out and purified. In such a case it is impossible to determine the best type simply by inspection, since there is no such thing as an "ideal type" recognizable as such on sight. Mass selection of a number of separate types would have given very little bulk of seed of each, and the sole advantage of such selection would have been lacking. It was decided, therefore, to concentrate entirely on single plant selections. The appearance of jassid later in the season settled this point still more definitely. The whole breeding work is so bound up with this pest that a detailed consideration is necessary.

Jassid, *Chlorita fascialis*, often referred to as a leaf hopper, is a very small-winged bug which breeds on the underside of the leaf and sucks the sap. The effect produced on the leaf appears to be due more to some poisoning action than to a simple depletion of sap, but nothing definite is known on this point. In a bad attack the older leaves turn red, and fall off; younger leaves curl up, turn reddish brown, and gradually shrivel and dry up; the whole plant dries up considerably, but the growing points may remain alive, and be capable of shooting again if the jassid disappears.

As the plant matures it becomes increasingly susceptible to jassid attack. Speaking quite generally, the damage does not become serious until many of the earliest bolls are practically mature. If the early setting is good, a fair crop may thus be obtained in spite of jassid, though, of course, the loss it causes is still serious. Where, however, as is often the case, bollworms have depleted the early crop of bolls and jassid prevents further setting, the position is most serious.

Jassid attacks have occurred over practically the whole of the low veld cotton belt, of which no part can be considered free. The intensity of the attack appears to depend largely on the season, more damage being caused in a wet season. At the best the pest is a serious one, which must be overcome if the cotton-growing industry is to be a success in the low veld.

It has been known for many years by workers in various countries that susceptibility to jassid and similar leaf hoppers varies largely with the variety, and depends to a great extent on the degree of hairiness of the leaf. Resistant types have been raised in India, and one of these, a selection from Cambodia, was sent by the Cotton Specialist, Madras, to Mr. Worrall, Tobacco and Cotton Expert, Barberton, who had written an article on the subject.

The effect of jassid on the different varieties and strains grown has been carefully noted throughout the season. Of the Union varieties Watts' Long Staple is uniformly very susceptible. All the others are very mixed, and show great variation from plant to plant, though the proportion of plants showing any given degrees of susceptibility varies a great deal with the variety. Of the imported varieties Cambodia, already mentioned, *shows complete immunity;* the jassid appears not to breed on it or damage it in the slightest. The varieties from the United States of America were all rather susceptible, and Webber 49 is the only one which offers any hope of possible improvement by selection. A number of strains of Improved Bancroft from the Rustenberg Experimental Station and two strains of Meade raised by Mr. Worrall were all too susceptible to be of any value, though one of the Meades might be useful for further selection.

The single plant selections from Zululand Hybrid proved extremely interesting. Some lots were more or less mixed, whereas others, especially such as were uniform in habit and general appearance, showed considerable uniformity as regards susceptibility to jassid. Of the uniform lots many were distinctly susceptible, whereas others showed definite resistance of various degrees. The best lot, Z.1. of the table below, was uniformly good; all plants remained green throughout the attack and are now (early May) still healthy. In many of the worst lots every plant was brown by the end of March. There could be no better demonstration of the *inheritability of jassid-resistance* and of the corresponding possibility of breeding resistant strains from the present mixed varieties.

Variety.	*Degree of Attack.*				
	Nil.	*Slight.*	*Moderate.*	*Rather Bad.*	*Bad.*
Cambodia	100	—	—	—	—
Z.1.	4	60	36	—	—
Uganda	3	8	27	32	30
Improved Bancroft ..	—	3	12	38	47
Zululand Hybrid ..	—	2	14	38	46
Griffin	—	—	2	27	71
Watts' Long Staple ..	—	—	—	—	100

The table given on p. 334 shows an analysis of a number of varieties growing side by side. Every plant was roughly classified according to the degree of damage by jassid on April 11. The figures show the percentage of plants of the different degrees.

The strain of Cambodia imported is very markedly resistant, the boll is large, and the lint of many of the plants is over 1⅛ inches in staple. The habit, however, as it has grown this season, makes it of doubtful value as a field crop. It is very large, some of the plants being 8 or 9 feet high, and almost as much in diameter, and the stems are rather weak and delicate, making it subject to serious damage by wind. It may settle down to a more reasonable habit after a few seasons in this country. It is hoped to obtain other less rampant strains from India for trial next season.

The best single plant selection out of Zululand Hybrid, Z.1. of the above table, is suitable for immediate multiplication. It is markedly uniform, strong growing, rather lax and upright in habit, big bolled, well over 1⅛ inches in staple, and definitely resistant to jassid. The number of bolls is only fair for the size of plant, but the yield per plant will be uniformly good. A number of plants of this strain, many of which are selfed, have been selected for planting separately next season to purify and improve the strain still further if possible. The bulk seed should plant about 5 acres next season, and thus give enough seed to put out for multiplication if the strain proves good enough.

Single plant selections have been made from fields of Improved Bancroft and Zululand Hybrid specially grown for this purpose. Fortunately both fields were attacked by jassid, and it was thus possible to pick out resistant plants, which showed up strikingly green amongst the general reddish-brown mass. It is practically certain, in view of the behaviour of the Zululand Hybrid selections this year, that many of these plants will give rise to markedly jassid-resistant strains. About 150 plants have been selected so far, all of good types, carrying a large crop of bolls, and nearly all with lint of about 1¼ inches staple. On the whole the Bancroft selections appear to be most promising, as they are generally of a better habit and carry a larger boll than those from Zululand Hybrid. A few selections from other varieties have also been made.

It may be noted that all the resistant plants are distinctly hairy, though all hairy plants are not necessarily highly resistant. The resistance appears to be due partly to some degree of immunity from attack and partly to a constitutional power of tolerating the action of the pest. In fact, the resistant plants give the impression of being specially tough and hardy, and capable of withstanding all vicissitudes better than the average plant.

It will be seen that there is every reason for hoping that the jassid problem will be solved satisfactorily in the very near future, thus removing one of the most serious obstacles to the successful development of cotton-growing in the low veld areas.

This note cannot be closed without some reference to the very willing support and assistance given by the cotton growers of the district. Through the good offices of the De Kaap Agricultural Society, the Barberton Municipality has offered to the Department of Agriculture, practically free of rent, 100 acres of land for experimental and plant-breeding purposes. It is hoped that a proper cotton breeding station will be opened on this land for next season. A sufficient area for next season's crop has already been cleared and ploughed free of charge by the Society, in order that the broken land should receive the late rains, and thereby become more fit for experimental work. The land is in a solid block, very level, and possessing a deep, uniform, good soil thoroughly suitable for experimental work. The situation of the De Kaap valley midway down the cotton belt, its easy accessibility by rail, the existence of a well-controlled ginnery and good organization for seed supply and distribution, the constant presence of jassid for testing strains, and the existence of large stores from which sudden urgent requirements of the work may be obtained, are all factors which make Barberton a very happy choice for the new station.

An experiment was started in which the same set of varieties were planted side by side at Barberton, Malelane, and Candover. From the results so far seen, it would appear that a variety good in one of these areas would also do well in the others. If this holds good as a general rule, it will greatly simplify the work of producing strains suitable for the various parts of the low veld area.

BARBERTON,
May 5, 1925.

DEVELOPMENT OF COTTON LAND ON THE GEZIRA PLAIN

BY

C. M. HODGKINSON.

SINCE the months of September and October, many inspectors have found themselves transferred from the existent cotton fields into those new areas which are to be sown in the coming July. It is a very different landscape that they come to. In place of wide green expanses where cotton and loubia (a leguminous fodder crop) are under irrigation, one finds an enormous flat plain uniform in its bleakness. Here and there absolute monotony is broken by a village or an occasional clump of trees. The latter are situated either on sites of cemeteries and old villages which have long ago disappeared, leaving only mounds and depressions in the sandy azaza soil, or in low-lying luggard land. Most of the land in October is still standing with the ripening crops of doura. This, by November, has lost its fresh green colour, and is becoming yellow, dry, and brittle. It is the staple native crop on the plain; in fact, except for green patches of rain cotton here and there, it is the only one. It consists of tall upright stems, surmounted by a large head of grain, which is white when ripe. After a good rain the plants may stand as much as 6 feet in height. It is the crop on which the native relies solely for his existence—a bad crop may result in widespread famine. The grain forms the chief part of his normal food, and from it also he brews merissa, his equivalent of beer. The straw is as important, both for the feeding of goats, donkeys, and camels, and for the thatching of houses. Where doura has not been sown there grows a tall grass called nāl. By October this also is dry and yellow, the whole country thus having a dry and thirsty appearance. After riding for some hours over such country under a blazing sun, the existence of a village near at hand is something to be grateful for. A village is composed of a cluster of round mud houses, capped by a conical roof of straw. Camels and donkeys are tethered here and there, sheep and goats wander at their will, often into the houses. Women draped in their characteristic blue garments move to and from the village well, large earthenware vessels on their heads. Each has her length of rope and her water skin, and round the somewhat raised mouth of the well there is gathered an active, gossiping crowd. Here it is a tired pony gets his drink. On entering the village invitations to drink water and coffee are immediately thrust upon one. Once having accepted it is a long undertaking. The water is usually much sweetened with sugar, or has flakes of baked doura floating in it. Very sweet tea and very sweet coffee follow this. The coffee is most excellent, the other drinks are possible only when a genuine Sudan thirst has been accumulated. The houses are wonderfully cool, and one is made comfortable on a couch and mattress covered for the occasion by a rug. The natives make the most courteous and kindly hosts. It is fatal to go into a village with the intention of doing a strafe, and to accept their hospitality; the strafe at once becomes an impossibility. The only thing is to refuse their offers, declaim from horseback, and to ride away.

When one has time to think of it there is something romantic in converting this great stretch of formerly unproductive land into a plain, green with cotton. The initial work of development is, moreover, of a satisfactory kind in that it shows results according to the work put into it. When you are growing cotton, on the other hand, you work like a slave, and your cotton dies—at least it always seems to. Out in the blue one forgets the heartbreaking damage being caused some miles away in the old cultivation by bacteria and insects. It is, moreover, a good change from the daily routine on cotton where one is dealing with natives who are no longer strange to the work, and who know fairly well what to do, even if they do not do it. It is more interesting to deal with the quite raw material. They know nothing, and everything must be drummed into them. Some are keen, some disgusted with the idea of having to do a genuine job of work. Except during the few months of the year, when they sow and harvest their doura crop, it is hard to imagine how they originally spent their time, what they talked or thought about. They now, at any rate, have plenty to discuss, whether it be their luck on the last pay day, or the methods of their inspector, his severity or gullibility.

The ploughs start their work as soon as possible after the rains, and before they come the plots of land to be sown the following year have to be marked out and cleared of trees. They are called "trees" here, but in reality they are nothing more than small thorny bushes, rarely more than 2 feet high. However, what they lack above ground they make up for in their roots below. They are insignificant enough to look at, but if overlooked they make their presence felt on the unhappy cultivator that may cross their path. A pair of ploughs, working from sunrise to sunset without stoppages, will cover 30 acres or more in a day, and two or more pairs can cause an inspector many an anxious moment.

The allotting of the 10-acre plots (hoarshas) to prospective tenants is done, village by village, by the senior inspector of the area, accompanied by the block inspector. And long tedious days they are, seated in a mud house at a small rickety table and surrounded by maps, notebooks, coffee, and natives. Each landowner is entitled to one hoarsha, and any land remaining he allots to his sons, relations, and friends. Each one of these has to be seen in order to make sure that he is not nominating infants in arms, or even babes unborn! Where possible they are given their hoarshas on their own land and near their villages, but it invariably takes them much time and discussion to decide where they actually do want them. Many leave it solely to the inspector, some are suspicious of being given bad land, and some are impossible to satisfy whatever land they are offered. But, in the long run, they cheerfully take what is given them.

Their first job after receiving their 10-acre plot is to dig their minor irrigation channel—½ metre square in section, and 280 metres long. Of the whole year's work I think this is the job they like the least, and it takes many of them several months of grievous toil! Each tenant has also to build a straw house, a thing about which they really do know something. They are expert thatchers, and they appear to enjoy the work. There always is gathered a particularly cheerful group, from boys to old men, when a house is in course of construction. About March or April the ploughing engines return, this time to make the ridges on which the cotton will eventually be sown, and bulls afterwards plough irrigation channels across them, so that every hoarsha is divided into sixteen "angaias." Each of these is afterwards irrigated separately. The tenant makes up the channels and every ridge with a native implement called a torea. The hoarsha is then ready for sowing. To an Englishman it does not seem that the tenant has much to complain about on the side of hard work, but to a habitual sunbasker it seems to be rather trying. They are a most exasperating race of people from whom to extract work! They seem to have an eternal dread of doing more work than is absolutely necessary. Having *nearly* finished a job, they cease work on the off-chance, I suppose, that the inspector may take their work over. Being told that this is not enough, they give it another sparing scratch, and arrive with beaming face to say that this time it really is finished. This may happen many times, with the result that they may not get paid for weeks after they have broken the back of the work in hand. However, after a time one gets accustomed to expecting only a little at a time. Their difference of outlook on life, combined with the heat, make one very apt to lose all patience. But patience pays, and they appreciate it. To show the stupidity that they can exhibit on occasions, there is the case of the tenant who found a loose rail lying across the path of the water channel he was digging. These channels, I may say, must essentially be dead straight. But no, he did not move the rail. He dug round it in a cunning semicircle, thus adding a few more grey hairs to his inspector's head!

Changes in landscape take place with sudden rapidity. A few weeks may see a bungalow where no bungalow stood before. Light railways appear and disappear like mushrooms. One day lorries may drop poles at intervals along the road to your bungalow, and in a day or two a line is laid, and a telephone installed. Old roads that have been used from time immemorial are ploughed up and intersected by canals and all manner of channels. Their place is taken by newly made roads, which cross canals by regulators, and which run by the side of, instead of across, the cotton fields. In the transition stages it is frequently difficult to find a road at all, owing to canal regulators not having been built. It is one of the most annoying things on earth, in a car, to find one's old road completely blocked and to be compelled to make, in the heat of the day, or at night, a long detour to get to one's destination.

In these days the Gezira swarms with large gangs of Sayidees, a race of people who live in southern Egypt, and who are introduced to this country when there is really strenuous digging to be done. Without them the Makwar dam and the whole Gezira scheme would have been almost impossible. They are very unlike the Arabs in every way; they have not their courteous manners, but they have a capacity for work which must make the natives gape with wonder. Their energy and the speed with which they can dig a canal is truly amazing. They simply eat earth! It is a pathetic sight to see a tenant toiling away alongside at a small channel which will probably take him months to finish.

To look, now, at this bare expanse with so much work not finished and so much not begun, it seems impossible that in August (less than five months ahead) cotton will be seen appearing over thousands of acres. It will have been a great achievement.

FOURTH ENTOMOLOGICAL PROGRESS REPORT (AUSTRALIA)

RECEIVED FROM

E. BALLARD,

Cotton Entomologist appointed by the Corporation, attached to the Commonwealth Government of Australia.

BRISBANE,
April 16, 1925.

IN my last report I dealt with the insect pest situation up to December last, when the crop was beginning to put on squares, and in some cases small bolls.

In the present report I give a short account of the work accomplished up to the time of writing.

It had been my original intention to work in three areas—the Cotton Research Farm at Biloela (or Melton), the Boyne Valley, and Gatton Agricultural College—these places being representative of conditions behind the Coastal Range, the Coastal area, and the South Queensland area respectively. My assistant was posted at Biloela, and a programme of work drawn up for him to follow, and a camp was established on the Boyne River, where I proposed to carry on the coastal investigations, working between there and Brisbane, and Gatton College.

As I arrived when picking was well advanced last year, I wished to have at least one whole season devoted to field observations before settling down to any elaborate experimental work. At the same time, there were certain matters which could probably be cleared up in this season, and experiments to this end were carried out at Biloela.

Difficulties of supply and transport made work at the Boyne Camp impossible. It had been originally chosen as a farmer in the vicinity had done work for the Agricultural Department, and I rented two acres of cotton from him for this season. The camp was given up shortly before Christmas, and attention concentrated on Biloela and Gatton, supplemented by short tours to check observations made at these two centres.

From observations made last year (1923-24 season), I arrived at the conclusion that the fungus diseases and internal boll rots so prevalent in the cotton, especially the coastal cotton, were largely due to punctures made by the large Pentatomid bug, *Tectacoris banksii* (*lineola*) (known locally as the Harlequin bug and Chinese bug, from its brilliant and diverse colouring).

Experiments were drawn up to check the accuracy of this observation, and were carried on at Biloela.

Flowers as they appeared in suitable positions were covered with voile cages, made to my design by the Red Cross Committee in Brisbane. (I should like, in passing, to pay my tribute of thanks to the ladies of this Committee, who took the greatest interest in the work, and worked far into the night in order to have the 300 cages ordered ready by the time they were required.)

The cages were so designed as to let in the maximum amount of air and light while excluding all possibility of any insects entering them other than those put in by me. The cages fulfilled their purpose admirably. In twenty of them Tectacoris bugs were introduced when the bolls were about four weeks old, in twenty others of the same age were put cotton stainer bugs (*Dysdercus sidæ*), species of which genus have been noted as doing great damage in other parts of the world by letting fungus diseases into the bolls. Others were kept as controls and for further experiments and to replace casualties.

The bugs were in all cases removed before the bolls ripened.

The results, which will be given in greater detail elsewhere, were badly interfered with owing to a very hot dry period in February, which was most unfavourable for the production of boll rot fungi and bacteria, and caused a great deal of premature opening of the bolls, resulting in small seeds and weak immature lint. From this cause the full effect of Tectacoris damage was not so noticeable, as the cotton was poor in any case. In spite of these unexpected developments, the assumption that Tectacoris in a greater degree than Dysdercus was responsible for the large amount of stained and wasty cotton was justified.

Apart from the boll rot stains on the cotton, many of the seeds were damaged before the bolls opened—*i.e.*, 229 out of 611 seeds examined. It is not always possible to differentiate between developing seeds damaged by insects and those damaged by drought, as in both cases the embryo shrinks, but a sufficient number of cases of undoubted insect damage were found to establish the case against Tectacoris. The figures for Dysdercus are not yet completed, but were less than those for Tectacoris. Tectacoris has a very long proboscis, and is able to pierce right through the boll wall and get well into the underlying seeds. Dysdercus only comes to the cotton after the bolls have opened. Once in the cotton it will feed impartially on green bolls or seeds in open bolls. Tectacoris, on the other hand, is in the cotton from the beginning, and stays until the crop is pulled out. Recent observations made at Miriam Vale on the coastal area showed in one plot of 30 acres 50 per cent. of damage from boll rots in the second crop now ripening, and an average of two adult Tectacoris bugs or last-stage nymphs per plant.

Egg-laying was proceeding briskly, and by the end of May the population in this particular plot (30 acres) should total about 4½ million. In other words, the second picking will be hardly worth taking.

Tectacoris is, fortunately, easily controlled by hand picking. The insects are large and lethargic, and congregate in their early stages in great masses. They are fortunately slow breeders.

In addition to this work the life-history of Tectacoris has been followed up, and should be fairly complete by the end of the season. Very few farmers realize the amount of damage done by this insect, and some, indeed, think it is beneficial ! It was important, therefore, to get absolute evidence of the loss caused by it. As time and improved laboratory facilities permit, a more thorough investigation of this problem will be undertaken. The co-operation of a mycologist would also be most useful.

Dysdercus is another problem, and a satisfactory control for it under Queensland conditions remains to be found. The widely scattered farms and abundance of alternative host plants in the intervening country will make the methods of control, practised in the West Indies, for example, impossible of application.

Apart from damage to the developing bolls and seeds, Tectacoris and Dysdercus, and the small cotton stainer Oxycarænus, all damage the seed in the open boll. Figures are being compiled, showing the damage of which all three are capable. The damage results in poor germination and loss of oil content.

It has been now shown that this damage is that shown in my report to the Government. I am still not satisfied that the condition of the attacked seeds is entirely due to mechanical injury, and am inclined to suspect that in some cases bacterial activity enhances the damage done by the piercing stylets of the proboscis of the bug and the enzymic action of its salivary secretion.

An experiment was laid down at Biloela for checking the efficacy of a trap crop of maize to attract the maize grub, *Heliothis* (*Chloridea*) *obsoleta*. This insect reaches its maximum intensity about December or early January, at the time when squares and flowers and young bolls are being most abundantly produced, and at first concentrates its attack on the squares.

The figures so far obtained show that 5·4 per cent. of the plants in plots of cotton with the maize trap crop were attacked by boll worms of all kinds (though Heliothis was in a great majority), while of the plots located as far from maize as we were able to get 16·6 per cent. of the plants were attacked. The odds in favour of this difference being due to the presence of the maize and no other factor are very high indeed, and show that an intelligent use of maize should in normal years solve the maize grub problem. I might add that in January and late December the farm was alive with Heliothis moths, which were flying everywhere, so that the comparative immunity of the trap crop plots was not due to lack of insects.

One very interesting point brought to light by widespread field observations was that maize is more attractive to the maize grub than cotton from its earliest stages, and not only when in silk, as was previously laid down by numerous workers. The importance of this observation lies in the fact that one does not have to have a continuous supply of maize in silk to act as a trap. As long as the maize is green eggs will be laid on it. (As many as twenty or over have been observed laid on one small plant amongst the cotton in a single night.) It is possible that this observation has been made by some other worker, but it has never come to my notice.

Heliothis is not an insect which has definite broods; eggs are being laid continuously from October or November to February or March, so that to guarantee maize in silk during all that period would be impossible.

(One large estate of 400 acres is going to plant maize trap crops under my direction next year, which should afford a very good demonstration.)

I might say in passing that failing the trap crop method, practically no course is open at present to the farmer for controlling this pest. Dusting is almost out of the question owing to the high cost of materials, and spraying impossible owing to the difficulty of water supply and cost of machinery

While on the subject of trap crops, I must mention the Peach Moth (*Dichocrocis punctiferalis*).

It was stated above that Heliothis tends to diminish in numbers as the season advances. (This is due presumably to the eight diseases and parasites which control it and an increase in the length of the pupal period.) The Peach Moth, however, carries on the work, and reaches its maximum about March, April, and May, thereafter hibernating as a larva over the winter.

Dichocrocis is equally attracted by maize, but seems to prefer it in a later stage than does Heliothis. It is especially fond of the "tassel" and goes later into the cob. At Biloela it attacked cow peas in preference to cotton, and appears also to like sunflowers.

Maize at Gatton was found to be heavily infested with Dichocrocis at a time when none was to be found on the cotton, and the pest is at the time of writing, coming into the cotton now that no tasselling maize is near-by. Another point in favour of trapping Dichocrocis lies in the fact that it appears to have a very much more definite series of broods without the large overlap observable in the case of Heliothis.

Maize coming into tassel in February and being cut in March should be effective in controlling this very destructive pest, but further observations are required. The eggs of Dichocrocis were definitely identified for the first time last year by Mr. C. G. Girault, Assistant to the Government Entomologist, Mr. H. Tryon. We experienced great difficulty in getting moths to lay in captivity, but this has now been effected at Biloela, and, in addition, many eggs have been collected in the field on cotton bolls.

A plot of thirty acres of cotton was mentioned above in connection with boll rots. The bolls of the second crop in this plot showed 27 per cent. infestation of Dichocrocis; other boll worms: Heliothis nil, Earias nil (or so small as to be negligible), pink boll worm (Platyedra) 6 per cent. A brood of Dichocrocis was egg-laying at the time the observations were made, and the insects found were either full-grown larvæ, pupæ, or eggs and recently emerged larvæ, helping to prove my observation that the overlap is very small. (In the case of a crop infested with Chloridea or pink boll worm all stages are present at the one time.)

It is very characteristic of Dichocrocis to attack bolls from below, so that often no external signs are noticeable when the boll might be riddled internally. This led early in the season, before any microscopic examination was possible, to the confusion of another larva with a young Dichocrocis larva. This other larva was *Eucosma plebiana*. Its most destructive time is from October to Christmas, in which period it has two broods—the latter heavily parasitized.

In that short period the damage it does is very considerable. It first attacks the terminals, then the squares and small bolls. Its method of attack is identical with that of Dichocrocis, and the larvæ similarly marked. In only one part of the cotton belt was Eucosma a serious factor after Christmas, and then it was in an area of red scrub soil markedly deficient in potash and phosphate. The forest soil adjoining the scrub was not attacked. Many field observations have led me to the conclusion that there is an intimate connection between soils deficient in these constituents and insect attack on cotton by certain species. Later experiments in this direction should be carried on under controlled conditions. This point will be taken up later in this report.

Parasites, owing probably to the very mild winter and early summer, have been very much in evidence, and specimens have been received of parasites of all the insects so far mentioned, with the exception of Oxycaræenus. Heliothis was particularly heavily parasitized as the season advanced.

THE PINK BOLL WORM.—The prophecies about the pink boll worm made last year have been amply fulfilled. Ratoon and stand-over cotton coming into the ginneries from the central districts is literally crawling with larvæ. So far no new area has been infected, and the twenty-sixth parallel remains the southern boundary. There is no doubt that the large area of abandoned and standover cotton, the early ripening of the ratoon, and the non-enforcement of the Cotton Act all contributed to giving the pink boll worm a flying start this season. So long as it is impossible to enforce legislation, and farmers will not take action themselves, the pink boll worm will flourish. In my opinion it will be the deciding factor in the central district as to whether or not it will be possible to grow cotton.

It is to be hoped that all the efforts that are being made to keep it out of the areas at present free will be successful. But it is an insect which appears to be very clever in overcoming barriers erected to keep it at bay. It has penetrated into nearly all cotton-growing countries.

The question as to whether or no it is indigenous to Australia is a very difficult one to settle, but does not affect the main issue, since it is indigenous to India, and can be controlled there.

Before leaving specific pests and coming to general questions, I must mention an insect, a Coreid bug, Homæocerus sp., which appears early in the season and, piercing squares, flower buds, and young bolls, causes them to be shed.

The young bolls show symptoms of bacterial infection similar to those noticed in India, a report on which appeared in the *Agricultural Journal of India* (Ballard and Norris, vol. xviii., part i.). Tectacoris also causes shedding in this way.

Homæocerus, which is rather like Dysdercus in general appearance, lays its eggs on the leaves, and not, like Dysdercus, in the ground. The eggs are heavily parasitized, which probably accounts for the fact that the bugs get very scarce after December.

The question of soil deficiencies and insect pests offers a very wide and important field for research. In Queensland, apart from the case of Eucosma given above, there is the example of a jassid or leaf hopper. This was seen in great numbers at Mount Larcom last year. I was certain, from former experience, that the increase in hoppers and the poor appearance of the plants was due to a soil deficiency, and that the hoppers were a symptom rather than the disease. Soil analysis showed a phenomenal lack of phosphates and potash.

On the line between Rockhampton and Emerald a certain district suffers annually from this same leaf hopper; here again, the cotton is grown in soil which is 15 feet of almost pure sand, and again shows a potash deficiency. As the area involved was so small, I did not feel justified in taking up the question this year, nor will it be justified for some little time to come, as other universally distributed pests claim first attention. These are the only places where leaf hopper is abundant; a few are found in any crop.

Andrews in Assam did the classic work on the subject of potash deficiency as it affected tea; and in the future work of this kind is called for anywhere where jassids are very abundant. Although I have never been able to prove the correctness or otherwise of the theory, if I find jassids in pest conditions on cotton I always look for soil or root trouble.

I attach very great importance to being constantly in the field, but certain laboratory work of more detailed kind, and under controlled conditions, is essential. This cannot be carried out at present, although it is hoped that a laboratory nearer to Brisbane than Biloela, which is most inaccessible, can be fitted up in the coming season.

This point has, however, been dealt with by the Cotton Advisory Committee, and I will not go into it further here.

A NOTE ON THE DIMENSIONAL CHARACTERS OF THE POLLEN GRAINS OF COTTON WITH SOME REFERENCE TO THEIR INHERITANCE

BY

HERBERT MARSLAND, B.Sc. (Edin.).

Introduction.—Very little work has so far been published on hereditary variations in pollen grain size within a species or group of species in a genus, although it is readily apparent that dimensional characters of pollen vary considerably in plants of different species.

Apart from a few determinations made by Tupper and Bartlett (1918) with regard to differences in pollen grain size between mutational forms of *Œnothera*, the work of Karl Sax (1921) on pollen grain size in various species of Triticum (wheat) provides the only example so far known of a statistical treatment of the size of pollen grains in certain species and their hybrids.

In his work with the Sweet Pea, Bateson (1913) mentioned the existence of two types of pollen, long and round, which in the F 1 hybrid show dominance of long, and in the F 2 generation give the usual 3:1 ratio of long to round. He also demonstrated the existence of linkage between pollen shape and certain flower colours.

It was shown by Denham (1924) that the chromosome numbers of Old and New World cottons fall into two groups of 26 and 13 chromosomes, the former comprising the cottons of the New World—*e.g.*, Sea Island, Upland, and Egyptian, and the latter those of Asia—viz., Indian and Chinese.

Method and Materials.—The method of measurement used was as follows:

Flowers were selected at random from plants in the experimental plots, and either bagged with muslin or tied up with lead wire or string. By bagging or tying up the flower buds before opening, a complete absence of extraneous pollen was assured.

Between the hours of 8.30 a.m. and 10.30 a.m., the approximate time of pollen shedding, the flowers were taken and examined.

The pollen was then shaken on to a slide coated with a thin film of liquid paraffin, and a rectangular coverslip placed in position, the slide then being ready for examination.

To prevent possible overlapping in measuring the grains, a mechanical stage was used so that fresh grains could be moved into the field of the microscope at will, thus ensuring that no grains were measured more than once.

The actual measurements of the grains were drawn on paper by means of a Zeiss Camera Lucida, so |————| .

Whilst no doubt this method is open to criticism on the grounds that a considerable amount of error may creep in on account of distortion of pollen grains, resulting in an extension or reduction of the length of the diameter lines drawn on paper, according to the distance of the pollen grains from the centre of the field, it was found to be the most suitable for the purpose. Each measurement was taken in the centre of the field, and only grains in such a position were measured. The setting up of the instrument each time was carefully adjusted to the same position and the same microscope used, thus giving the required degree of accuracy for such determinations. Two hundred measurements of each variety of pollen were made, and a frequency curve plotted for each series of two hundred.

All material used was taken fresh, and measured immediately on mounting, so as to obviate any possible errors due to expansion or contraction of the grains. Preliminary experiments, however, showed that the amount of swelling of the grains when immersed in liquid paraffin for one hour periods was for all practical purposes negligible.

The pollen grains of cotton are characteristic of the Natural Order Malvaceæ, being spherical and covered with spiny protuberances; thus throughout the whole series of determinations measurements are based on diameters measured from base to base of the spines.

Measurements and Results.—The results will be found in the form of frequency arrays in Table I.

The following are the main points of importance:

1. The arithmetical mean of the different varieties examined varies from 108μ in Upland to 135μ in one type of Marie Galante, and is continuous, showing no grouping of varieties for size.

2. The pollen grains of Upland and Indian varieties of cotton are the smallest, whilst those of Egyptian (Pima) and Marie Galante are the largest.

3. Pollen grain size is least variable in Indian with a coefficient of variability of 4·35, and most variable in the hybrid Mead by Sea Island with a C.V. of 7·64.

4. There is apparently no relation between chromosome number

TABLE I.—FREQUENCY ARRAYS OF POLLEN GRAIN DIAMETERS.

Cotton Variety.	1·6	1·7	1·8	1·9	2·0	2·1	2·2	2·3	2·4	2·5	2·6	2·7	2·8	2·9	*n.*	*Mean.*	*P.E.*	*Mode.*	*Diam. in μ.*	*S.D.*	*C.V.*
Upland	1	15	31	48	63	30	10	1	1	—	—	—	—	—	=200	1·95	0·0064	2·0	108μ	0·1352	6·93
Upland × Egyptian	—	—	2	1	4	12	22	50	65	29	11	4	—	—	=200	2·35	0·0073	2·4	129μ	0·1527	6·49
Pima	—	—	3	—	2	4	15	25	53	58	31	7	2	—	=200	2·43	0·0076	2·5	135μ	0·0261	6·625
Sea Island × Upland	—	—	—	—	4	9	21	68	58	31	7	1	—	1	=200	2·35	0·0062	2·3	124μ	0·1304	5·53
Sea Island	—	—	—	—	6	20	35	52	40	30	14	3	—	—	=200	2·33	0·0074	2·3	124μ	0·1555	6·67
Indian	—	—	1	19	89	66	23	1	1	—	—	—	—	—	=200	2·05	0·0040	2·0	108μ	0·0888	4·35
Marie Galante . .	—	—	—	—	—	—	10	29	37	53	36	20	10	5	=200	2·50	0·0077	2·5	135μ	0·1625	6·50
G. Brasiliense . .	—	—	1	—	14	34	48	50	34	11	6	2	—	—	=200	2·26	0·0072	2·3	124μ	0·1526	6·75
Bourbon	—	—	1	16	56	60	47	16	3	1	—	—	—	—	=200	2·10	0·0056	2·1	113μ	0·1189	5·66
Mead × Sea Island	—	2	2	1	20	30	55	52	17	14	4	1	2	—	=200	2·23	0·0081	2·2	118μ	0 1707	7·64

Measurements in cms. Mag. × 185.

and pollen grain size—*e.g.*, Indian is 108μ in diameter, and Upland 108μ also.

5. In Upland and Sea Island the F 1 has the same value as the higher parent with a slightly lower value for the C.V.

In the next cross, Egyptian × Upland, the F 1 value is very close to the Egyptian parent, with a lower C.V. than either parent. Large pollen grain thus shows complete dominance over small in these two cases, but no F 2 data are available for testing possible segregation.

6. Bourbon (probably *G. purpurescens* Poir or a variety of this species) is morphologically closely related to Upland, and possesses pollen grains of practically the same dimensions.

7. *G. brasiliense* Macf., which belongs to the same group as Sea Island, also possesses pollen grains of practically the same size, the frequency curves possessing a mode of 2·3 in both cases.

In view of the comparatively large amount of data provided by Sax's work on pollen grain size in Triticum, it will be of interest at this point to give his results for comparison with those of cotton, together with those of Tupper and Bartlett, on pollen grain size in mutational forms of *Œnothera*.

TABLE II.—POLLEN GRAIN SIZE OF TRITICUM (SAX.).

Variety.	*No.*	*Mean (Microns).*	σ	*C.V.*
Kubanka	90	55·6±0·3	4·3±0·2	7·07
Marquis × Kubanka	106	63·1±0·4	6·5±0·3	10·3
Kubanka × Marquis	84	53·7±0·5	6·7±0·3	12·5
Marquis	92	60·3±0·3	4·1±0·2	6·7
Alaska	94	57·1±0·3	4·7±0·2	7·1
Alaska × Kubanka	117	57·0±0·4	6·3±0·3	11·5
Einkorn	82	51·5±0·3	4·5±0·3	8·7

The range of variability of pollen grain size of the different varieties of wheat is considerably in excess of that of different varieties of cotton.

The grouping of species of wheat after Schulz (see Von Tschermak, 1914), together with their chromosome numbers according to de Mol (1924), is as follows:

1. The Einkorn group, including Einkorn. Chromosome number 7 (Haploid).
2. The Emmer group, including Kubanka and Alaska. Chromosome number 14 (Haploid).
3. The Vulgare group, including Marquis. Chromosome number 21 (Haploid).

Thus, again, contrary to what obtains in the case of varieties of Old and New World cottons, it would appear that the greater the chromosome number the larger the size of the pollen grains.

Turning now to the work of Tupper and Bartlett on mutational forms of *Œnothera pratincola*, the following table is given:

TABLE III.

	Mean Diam. in mm.	*C.V.*
(*a*) F. *typica*	0·096	4·17±0·47
(*b*) Mut. *latifolia*	0·111	5·50±0·62
(*c*) Mut. *latifolia*	0·106	5·90±0·40
(*d*) Mut. *gigas* (?)	0·146	6·14±0·29
(*e*) Mut. *gigas* (?)	0·141	4·17±0·20
(*f*) Mut. *gigas* (?)	0·131	4·23±0·29

The coefficient of variability is less variable than that for wheat, and approximates more nearly to that for cotton.

It was suggested by Tupper and Bartlett that the chromosome number of mut. *latifolia* is 15, and of mut. *gigas* (?) 21, so that from the table it would appear, as apparently is the case with Triticum, that increased pollen grain size is closely correlated with increased chromosome number.

Summary.—1. Differences in pollen grain size are characteristic of different varieties of cotton.

2. No correlation apparently exists between chromosome number and size of pollen grains.

3. The F 1 hybrid shows the pollen dimensions of the large pollen parent.

4. The variation in the size of pollen from different varieties is continuous, from 108μ to 135μ.

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This problem was suggested by Professor S. C. Harland, and I acknowledge with pleasure the advice and assistance given by him during the progress of the work.

July 30, 1925.

COMPARATIVE COTTON PRICES

BY

JOHN A. TODD, M.A., B.L.

In the issue of October, 1924, we gave some historical records of cotton prices in three tables. The first of these dealt with the history of cotton prices from the beginning of the nineteenth century, and we reproduce the latter part of that table from the beginning of the present century, brought down to date. From this it will be seen that all varieties except Egyptian have suffered a substantial decline during the past season. The striking feature of the season has been the alteration in the relative value of American and Egyptian. This is borne out in greater detail in Table II., which gives the Spot Prices of American and Egyptian in Liverpool, Alexandria, and New Orleans on the last Friday of each month since 1922-23. In this table, as originally published a year ago, we included six seasons, which carried the history back to the previous period of record high premiums for Egyptian in 1920, when the premiums went as high as 211 per cent. in Liverpool in April, and 306 per cent. in Alexandria in August. 1923 provided the opposite extreme, when the premium fell to practically nothing at all.* 1924-25 has again illustrated the inevitable reaction, the premiums this season having been as high as 175 per cent. in Liverpool, and 189 per cent. in Alexandria.

Table III. gives the Monthly Spot Prices of other varieties in Liverpool for the same three seasons. Here, again, there has been a development of particular interest in the relative prices of these varieties compared with American. Space will not allow of this being worked out for all the varieties, but in the case of Indian we have worked out the percentage on American each month, and this shows a range which, while far smaller than in the case of Egyptian, still shows considerable variation—*e.g.*, in June, 1923, when American was 16·67d., Indian was only 62 per cent. (10·40d.), but in November, 1924, with American down to 13·59d., Indian had actually risen to 12·00d., making the percentage 88.

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* In the previous issue the Egyptian premium in June, 1923, was by an error given as 3 per cent. instead of - 3 per cent.

TABLE I.—HISTORY OF COTTON PRICES, 1899-1925.

SEASONS AVERAGES.

Season.	*Liverpool Prices (Pence per Lb.).*					*Alexandria.*	*American Price of Upland.*	*Year.*	*Index Numbers of General Prices.*
	Sea Island.	*Brazil.*	*American.*	*Indian.*	*Egyptian.*				
		Pernam Fair.	Middling.	No. 1 Fine Oomra.	F. G. F. Brown.	Dols. per Kantar.	Cents per Lb.		
1899–1900	16·7	5·06	4·87	4·40	6·81	12·28	7·60	1900	100·0
1900–01	16·4	5·50	5·16	4·37	6·87	13·80	9·30	1901	96·7
1901–02	19·3	4·87	4·78	4·19	6·31	10·42	8·10	1902	96·4
1902–03	*25·00	5·57	5·44	4·47	8·44	13·65	8·20	1903	96·9
1903–04	28·40	5·16	6·94	5·56	8·56	16·65	12·16	1904	98·2
1904–05	27·12	5·25	4·93	4·62	7·37	13·97	8·66	1905	97·6
1905–06	26·38	6·23	5·94	5·00	9·25	15·09	10·94	1906	100·8
1906–07	36·70	6·97	6·38	4·87	10·37	19·16	10·01	1907	106·0
1907–08	35·59	6·79	6·19	5·03	8·81	18·21	11·46	1908	103·0
1908–09	23·39	5·84	5·50	4·94	8·44	15·46	9·24	1909	104·1
1909–10	32·85	8·34	7·86	†6·06	13·12	23·30	14·29	1910	108·8
1910–11	35·62	8·27	7·84	6·78	10·75	20·66	14·69	1911	109·4
1911–12	23·73	6·70	6·09	5·44	9·56	17·25	9·69	1912	114·9
1912–13	25·00	7·11	6·76	5·91	9·79	18·28	12·20	1913	116·5
1913–14	23·47	7·47	7·27	5·62	9·45	19·02	13·49	1914	117·2
1914–15	22·00	5·71	5·22	4·19	7·34	12·01	7·94	1915	143·9
1915–16	27·00	8·22	7·51	5·79	10·42	19·28	11·99	1916	186·5
1916–17	50·00	13·03	12·33	9·92	21·56	37·81	18·41	1917	243·0
1917–18	80·00	24·13	21·68	16·10	‡30·97	38·52	28·86	1918	267·4
1918–19	65·00	23·96	19·73	17·15	27·85	37·20	30·36	1919	296·5
1919–20	—	30·00	25·31	18·05	60·34	87·81	38·21	1920	365·7
1920–21	—	13·24	11·89	8·21	30·24	34·50	16·08	1921	229·7
1921–22	—	11·40	11·37	8·72	19·75	34·28	17·78	1922	185·0
1922–23	—	14·62	14·92	10·25	17·29	30·71	24·06	1923	185·3
1923–24	—	18·20	17·66	12·37	21·55	39·79	31·67	1924	193·6
1924–25	—	14·67	13·76	11·04	29·82	§39·49	24·27	1925	—

* South Carolina. † No. 1 Good Oomra. ‡ F. G. F. Sakel.

§ 10 months average. These prices are F. G. F. Brown till 1914, since then G. F. Sakel.

TABLE II.—SPOT PRICES OF AMERICAN AND EGYPTIAN COTTON IN LIVERPOOL, ALEXANDRIA, AND NEW ORLEANS ON THE LAST FRIDAY OF EACH MONTH.

Month.	*Liverpool.*		*Premium per Cent.*	*New Orleans American Middling.*	*Alexandria F. G. F. Sakel.*	*Premium per Cent.*
	American Fully Middling.	*Egyptian F. G. F. Sakel.*				
	Pence per Lb.	Pence per Lb.		Cents per Lb	Dollars per Kantar.	
1922–23.						
August ..	13·70	18·00	31	22·00	35·00	59
September ..	12·40	17·00	37	20·25	32·00	58
October ..	14·29	17·75	24	23·50	32·00	36
November ..	14·85	18·50	25	25·50	34·50	35
December ..	15·34	17·90	18	26·50	33·25	26
January ..	16·42	18·25	11	28·25	33·75	19
February ..	16·44	17·50	6	29·75	33·00	11
March ..	15·16	17·50	15	29·00	33·25	14
April	15·56	17·15	10	28·25	32·75	16
May	16·02	16·40	2	28·50	31·75	11
June	16·67	16·20	– 3	28·75	31·00	7
July	14·57	15·50	6	23·00	27·75	29
1923–24.						
August ..	15·18	16·75	10	24·75	31·50	27
September ..	17·11	18·35	7	28·50	34·87	22
October ..	17·88	18·75	5	30·50	34·87	14
November ..	21·72	26·70	23	35·75	50·37	41
December ..	21·17	24·30	15	36·00	45·62	27
January ..	19·81	23·35	18	33·50	44·62	33
February ..	17·63	20·50	16	29·63	40·50	36
March ..	16·46	20·60	25	27·50	40·00	46
April	18·20	23·40	28	30·88	44·62	44
May	18·23	23·10	27	30·88	44·87	45
June	17·43	23·60	35	28·80	44·37	54
July	18·29	25·00	37	30·00	47·27	58
1924–25.	*Middling.*					
August ..	15·76	25·15	60	24·82	47·75	92
September ..	14·09	25·25	79	24·80	42·50	72
October ..	13·58	25·60	89	22·85	46·00	102
November ..	13·59	26·20	93	23·70	47·87	102
December ..	13·24	29·35	122	23·75	57·37	142
January ..	12·92	31·75	146	23·75	61·87	161
February ..	13·94	34·90	150	25·30	67·63	168
March ..	13·88	36·35	162	25·10	72·37	189
April	13·40	31·60	136	24·45	64·12	163
May	13·04	30·25	132	24·05	60·37	151
June	13·53	32·05	137	23·90	63·12	164
July	13·53	32·45	140	24·25	59·89	152
1925–26.						
August ..	12·60	28·65	128	22·25	52·00	134

TABLE III.—MONTHLY SPOT PRICES OF VARIOUS KINDS OF COTTON IN LIVERPOOL, 1922-25.

ON THE LAST FRIDAY OF EACH MONTH. FROM THE LIVERPOOL COTTON ASSOCIATION'S WEEKLY CIRCULARS.

(*For American in Liverpool and New Orleans—and Egyptian in Liverpool and Alexandria—see Table II.*)

Seasons.	*Egyptian Uppers (F. G. F.).*	*Peru Smooth (Good Fair).*	*Peru Rough (Good Fair).*	*Peruvian Afifi (Good Fair).*	*Brazilian Pernam (Fair).*	*West African (Middling).*	*East African (Good Fair).*	*Indian No. 1 Good (Oomra).*	*Percentage of American FM/M.*
1922-23.									
August 26	14·75	15·55	13·75	13·00	13·20	11·80	14·00	10·45	77
September 29	13·50	14·25	14·00	13·00	12·15	10·75	13·00	9·45	76
October 27	15·00	15·99	14·50	13·50	13·89	12·74	13·50	10·20	72
November 24	16·00	16·85	16·00	14·50	14·60	13·35	14·25	10·65	72
December 28	15·90	17·34	16·00	14·75	15·09	13·84	14·75	10·45	68
January 26	16·50	18·27	17·25	18·50	16·37	15·02	15·50	11·45	70
February 23	16·25	17·89	17·50	15·25	16·14	14·89	15·05	10·80	66
March 28	16·80	16·51	17·50	16·25	15·01	13·76	14·05	10·00	66
April 27	16·40	16·36	17·50	16·50	15·11	13·86	14·30	10·00	64
May 31	15·95	16·51	17·50	16·00	15·47	14·01	14·00	10·15	63
June 29	16·45	17·32	17·50	16·00	16·07	15·69	14·70	10·40	62
July 27	15·85	15·57	17·25	15·50	14·07	14·07	13·75	9·85	68
1923-24.									
August 31	16·75	15·78	17·00	15·75	15·03	14·78	13·50	10·15	67
September 28	17·60	17·86	17·50	16·75	17·36	16·86	15·75	11·05	65
October 26	18·05	19·03	17·50	17·25	18·53	17·72	16·25	11·85	66
November 30	24·65	23·87	21·00	25·00	22·27	21·62	21·00	15·60	72
December 28	23·30	23·17	22·00	23·50	21·57	20·92	20·75	15·10	72
January 25	21·90	21·86	23·00	22·50	20·26	19·61	19·50	14·00	71
February 29	20·10	19·48	22·50	21·25	17·88	17·23	17·80	12·35	70
March 28	20·10	18·26	22·00	20·00	16·66	16·01	16·65	11·50	70
April 25	23·25	20·15	22·25	21·75	18·15	17·65	18·70	12·25	67
May 30	24·00	20·64	22·50	22·00	18·64	18·13	19·50	12·75	70
June 27	23·20	19·18	22·50	22·00	17·43	16·93	18·35	11·80	68
July 25	24·45	20·34	22·50	21·50	18·59	18·09	18·45	12·30	67
1924-25.									
August 29	21·65	17·91	22·50	21·50	16·16	15·66	16·70	10·90	69
September ..	19·95	17·14	21·00	19·00	15·39	14·39	15·20	10·80	77
October ..	17·25	16·58	20·00	19·50	14·83	13·43	16·30	11·70	86
November ..	17·90	16·04	19·75	20·50	14·79	13·14	16·40	12·00	88
December ..	19·15	15·49	19·75	21·50	14·49	12·73	16·00	11·50	87
January ..	20·05	14·87	19·75	22·50	13·87	12·38	16·35	10·60	82
February ..	19·90	15·89	19·75	22·50	14·89	13·45	17·60	11·55	83
March ..	21·05	15·83	19·75	22·50	14·83	13·60	17·70	11·35	82
April ..	20·15	15·15	19·75	22·50	14·40	13·10	17·15	10·75	81
May ..	18·55	14·49	19·75	21·50	13·74	12·45	16·20	10·15	78
June ..	18·55	14·93	19·75	21·50	14·18	12·85	16·10	10·35	77
July ..	18·80	15·23	19·75	21·50	14·23	13·00	16·00	10·50	78
1925-26.									
August ..	17·90	14·40	20·00	21·00	13·15	12·50	15·40	10·05	83

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

474. INDIAN CENTRAL COTTON COMMITTEE. We have received a copy of the "Statement of Receipts and Payments of the Indian Central Cotton Committee for the year April, 1924, to March, 1925," from which we learn that the cotton cess of 4 annas a bale on all cotton produced in India, and either exported from or consumed in any mill in British India, realized a revenue of £95,000. Out of this sum the expenditure on administration amounted to approximately £8,400, on grants-in-aid for agricultural research £14,300, and on technological research £13,000.

475. THE REVIEW OF AGRICULTURAL OPERATIONS IN INDIA, 1923 24, recently received, contains, among other matters, an interesting account of the operations of the Indian Central Cotton Committee, and of the research and experimental work carried out during the year by the various Indian States with a view to the improvement of the staple of Indian cottons.

476. PUNJAB 4F AND 285F COTTONS. DESCRIPTION. (Leaflets Nos. 28 and 29 of Dpt. of Agr., Punjab. Abstr. from *Summ. of Curr. Lit.*, vol. v., **13,** 1925, E. 71.) The farmers who grow 285F cotton are advised to keep their stocks pure. This strain differs from 4F in the following details: 285F seed is covered with a short white fuzz, whilst 4F seed is smaller, black, and almost naked. The lint length of 285F is about 1·2 inches, whereas 4F has a lint length of only 0·9 inch. In the field the 285F plants are tall and erect, somewhat like "desi," whilst 4F plants are somewhat spreading and bushy. In consequence, 285F takes up less room in the field, the rows being 2½ feet apart, as compared with 3 feet for 4F. A sowing of 60 per cent. more seed than 4F is required for 285F. Germination is also rendered more difficult by the close covering of fuzz, and a twelve hours' soaking before sowing is recommended. Both strains need regular waterings during September, October, and early November. Shelter belts for cotton in the dry tracts where hot winds prevail are also recommended. Parallel hedges, 20 yards apart, inside the fields, should be grown, and these may consist of such crops as *arhar* (*Cajanus indicus*).

477. POSSIBILITIES OF PRODUCING LONG STAPLED COTTON IN INDIA. By G. L. Kottur. (*Agr. Journ. of India*, vol. xx., **8,** 1925, p. 195.) A paper read at the Agricultural Section of the Indian Science Congress, Bangalore, 1924.

478. COTTON MILLS STATISTICS. INDIA. By J. T Marten. (Abstr. in *Summ. of Curr. Lit.*, vol. v., **7,** 1925, M. 16.)

COTTON IN THE EMPIRE (EXCLUDING INDIA).

479. The following Reports have recently been received:

Barbados. "Report of the Dept. of Agriculture," 1923 24.
Ceylon. "Year Book of the Dept. of Agr.," 1925.
Grenada. "Report of the Agr. Dept.," 1924.
St. Lucia. "Report of the Agr. Dept.," 1923.
Tanganyika. "Trade Report," 1924.
British Cotton Growing Association. Twentieth Annual Report, 1924.

480. From the *Ann. Rpt. of the British Cotton Growing Association*, 1924, we quote the following: "The results which have been achieved up to the present demonstrate that the British Empire is capable of producing suitable types of cotton, and in substantial quantities. The rate of progress in the future will largely depend upon the provision of improved transport facilities, such as the construction of new railways, roads, harbours, and in some cases irrigation works and drainage schemes. A number of Government Commissions have been sitting during the year making investigations into schemes which have been suggested for the construction of new railways, etc., and when the various Committees have made their reports it will be possible to judge what the attitude of the Imperial Government will be in regard to these new African railways. In certain parts of Africa the construction of lines already in hand, and the consequent economic development, will fully absorb the energies of the existing population."

481. ASIA: CEYLON. *Small Holders Cotton Growing Scheme in the Hambantota District.* By F. Burnett. (Abstr. from *Year Book of Dpt. of Agr.*, Ceylon, 1925, p. 31.) Cotton was collected at different centres. The total amount equalled 710 cwt. of clean and 15 cwt. of soiled cotton of a total value of Rs. 18,070,91. The results have encouraged the growers, and much more seed has been applied for.

482. *Cotton Cultivation in Ceylon.* By H. Don Clement. (*Text. Mercury*, 1925, **72**, Abstr. from *Summ. of Curr. Lit.*, vol. v., **11**, 1925, E. 63.) It is stated that good crops have been secured in certain parts of the island, and that the acreage is steadily increasing. The land is said to be excellent for cotton growing if a good irrigation scheme were established.

483. CYPRUS. (Abstr. from *Cyprus Agr. Journ.*, vol. xx., **2**, 1925, p. 42.) Owing to the ravages of the Cotton Boll Worms (*Gelechia gossypiella* and *Earias insulana*) the cotton crop for 1924 was a poor one. There was a marked increase in these pests, and an order was issued for the uprooting of all cotton stalks. This was not altogether a popular measure, but the farmers saw that unless very severe measures were taken they would ultimately be the losers.

484. IRAQ. Advices from Iraq state that cotton has not been extensively sown this year, the root reason being the lack of plough animals strong enough to do the preliminary cultivation. The condition of the crop, however, is good, and it is remarkably free from insect attack, particularly Spotted Boll Worm (*Earias insulana*).

In Northern Iraq small trials are being made with specially selected early varieties of cotton, with a view to testing the economic possibilities of sowing cotton after the depredations of locusts have finished.

In Middle Iraq early sown cotton has already made bolls.

At the Experimental Farm larvæ of *Platyedra vilella*, a near relative of the dreaded *Platyedra gossypiella* (Pink Boll Worm) have been noticed feeding freely on the growing shoots and buds of the cotton plant. The transit of this pest from hollyhocks, its normal host plant, to cotton is viewed with some alarm.

485. *Iraq (or Mesopotamia) as a Source for Increasing Raw Cotton Supplies.* (*Brit. Cott. Growing Assoc.*, No. 88, June, 1925, price 1s. By W. H. Himbury, General Manager.) A report on a recent tour undertaken by Mr. Himbury with the object of acquiring first-hand knowledge of the general conditions under which cotton is grown in Iraq.

486. *Report on a Cultivation Experiment with Irrigated Cotton in Iraq.* By R. Thomas and K. Sawhney. (*Memoir* No. 9, 1925, of *Dept. of Agr.*, Iraq.) Experiments were conducted to test relative yields of cotton on ridged and on flat land; the former proved to be the better. The ridged land also used less water.

487. AFRICA. We are indebted to the proprietors of *East Africa* for a copy of the souvenir number of their Journal, containing interesting and informative articles relating to the various East African Colonies, and to the exhibits of these Colonies at the British Empire Exhibition at Wembley.

488. NIGERIA. From a *Report on the Cotton Crop in Nigeria* for the six months ending March 31, 1925, recently received from the Director of Agriculture, we extract the following information:

Northern Belt. There was an increase of 50 per cent in the production of American cotton for export in 1924-25, which is attributed to an increase in the area cropped with cotton, and to the greater attention devoted to the proper sowing and good farming of that area. It is regretted, however, that the amount of cotton available for export will be less than was estimated, as some 2,363 bales of lint were destroyed in a fire which occurred at the Zaria ginnery late in March.

Owing to the fact that the unprecedently large cotton crop coincided with an exceptionally large ground-nut crop, it was feared that the existing transport facilities might prove inadequate, but timely assistance was rendered by the Railway Motor Department and by a private owner of motor transport in Ibadan, who provided lorries for transporting the cotton, and thus overcame the difficulty.

The market inspection and grading was carried out on practically the same lines as in previous years. In the Kano district it is hoped next season to establish three or four markets at distances of fifteen to thirty miles.

The prices paid this year have been relatively better than in recent seasons by about ⅜d. per lb. of seed cotton, as compared with current Liverpool prices for lint.

Middle Belt. The introduction of the system of inspected central markets in the Niger Province has resulted in increased production during the last two seasons, and steady progress is now anticipated. In the Ilorin Province the crop this year has been a relatively poor one, following, as has frequently occurred in the past, a heavy rainfall in October.

Southern Belt. The average yield per acre in the present season is believed to have been nearly as high as last year, and in view of the better price offered it is expected that the export will be greater than last season, probably over 9,000 bales. The Oyo-Abeokuta Provinces have been gazetted as cotton export areas, and central markets for grading have been established.

489. *Cotton Cultivation in Nigeria.* By C. J. Lewin. (*Trop. Agriculture*, vol. ii., 1925, p. 124.)

490. RHODESIA (NORTHERN). We have received from Mr. T. C. Moore, Cotton Expert for Northern Rhodesia, a report of a recent tour undertaken by him with a view to observing the occurrence, quantity, and type of insect pests and fungoid diseases affecting cotton in the fields, and the degree of resistance to these diseases shown by the different varieties planted. In all some 179 fields were inspected, and the damage from insect pests (particularly jassid) and fungoid diseases was found to be serious. The Improved Bancroft and Arizona types of cotton showed more resistance to, and quicker recovery from, the attacks of jassid and of fungi, and Mr. Moore advises growers to plant these varieties. He considers that more economic entomological research is necessary in the Territory, and that a variety of cotton must be bred that will prove suitable to the conditions of the country and resistant to the fungoid diseases (*cf.* p. 330).

491. *Practical Methods of Controlling Cotton Boll Worm.* By T. C. Moore. (Abstr. from *Afr. Cott. Journ.*, vol. i., **10**, 1925, p. 9.) The author states that the following methods have been practised with successful results, reducing the pests from an estimated 20 per cent. damage to under ½ per cent. damage in the course of three seasons:

1. Winter ploughing, combined with harrowing or rolling, to break up the cells in which the pupæ of boll worms overwinter in the soil.

2. Burning the old veld grass next to the cotton fields, as numbers of insects, especially stainers, hibernate round the edges of old fields.

3. Planting maize as a trap crop.

4. Frequent and thorough cultivation of the cotton fields at least every eight to ten days.

5. Dusting with Paris Green, calcium arsenate, arsenate of lead, or any other suitable arsenical poison, at the time when the insects are feeding on the leaves and before they are attacking the bolls. An efficient mixture recommended is 2 lbs. of Paris Green and 6 lbs. of air-slacked lime to an acre.

492. RHODESIA (SOUTHERN). From the *Rhod. Agr. Journ.*, vol. xxii., 1925, p. 331, we quote the following: "The experimental crop of nearly 4,000 acres planted in various varts of the Colony last year resulted in an average yield of about 145 lbs. of lint per acre. A considerable proportion of the acreage shown above was planted in unsuitable areas, which largely explains the low average yield for the whole of the Colony. In favourable areas a yield of up to 1,500 lbs. of seed cotton per acre was obtained in certain instances. There were in all 305 growers of this crop. During the present season it is estimated that a total of about 75,000 acres has been planted to cotton, spread over practically every district in the country. It is feared that some districts will inevitably prove unsuitable, and the Cotton Expert is of opinion that this season will prove that cotton can only be produced at a profit in certain areas of several districts."

493. We have received from the High Commissioner a copy of a *Review of Agricultural Conditions in Southern Rhodesia to June* 20, 1925, by W. E. Meade, from which we quote: "The winter so far has been unusually mild, slight frosts only being generally experienced in the Colony. The warm sunny days have helped to mature the cotton. The crop generally is late owing to the excessive rains and lack of sunshine, and in many places picking is just commencing. On the high veld bolls are only now beginning to open. The cotton grown on the high veld is disappointing everywhere, but in the low veld it has done wonderfully well considering the season that has been experienced. Picking is general in the low veld, and the quality is quite good, though the staple tends to be short compared with that of last year. Jassid has been prevalent all over the Colony, and there has also been abnormal shedding of bolls. The cotton throughout the Colony was planted a little too late, and some farmers made the mistake of planting too deeply; on the whole, however, the planting was on sound lines. Experience gained during the last two seasons appears to indicate that in the low veld, and in parts of the middle veld, cotton can be grown with success in a season of average rainfall. In the high veld cotton has yet to prove itself.

"It is thought that the ginneries now established, and in progress of erection, will be able to deal with the incoming crop. Several buyers have arrived in Salisbury for the purpose of purchasing cotton on the spot. Prices are lower than they were at this time last year. Indications point to a large increase in the acreage under cotton next season notwithstanding the adverse season experienced."

494. *A Community Ginnery.* By E. R. S. Cheales. (*Cott. News Wkly.*, vol. ii., 1925, pp. 463-5.)

495. SIERRA LEONE. (Abstr. from *Afr. Industries*, vol. x., **23**, 1925, p. 251.) Efforts are being put forth by the native in Sierra Leone to cultivate cotton. A considerable quantity of "Allen's Long Staple" seed was imported in 1922, and experiments were made in the Konno and Koinadugu districts. Through the kindness of the British Cotton Growing Association a further incentive was given to this industry in the gift of a cotton ginnery, which was erected at Boia towards the end of 1924. The first bale of " Allen's Long Staple " to be exported from Sierra Leone is on exhibition in the Pavilion at Wembley, and it is satisfactory to note that the quality of the staple compares favourably with that of the cotton grown in Nigeria, etc.

496. SOUTH AFRICA. *Cotton and Ranching.* By S. Milligan. (*The Sun and Agr. Journ. of S.A.*, April, 1925, p. 365.) In this short article Mr. Milligan suggests that the very large stores of cattle manure accumulating in the countless cattle kraals throughout the Union should be used on the ranches for the cultivation of cotton, which is both a producer of direct revenue and a cattle food. As an example, he states that if on a fairly large ranch 2,000 acres of the most suitable cotton land were set aside and fertilized with kraal manure, the net profit would almost certainly be from £8,000 to £10,000 with American cotton at 10d. per lb. at Liverpool. In addition, there would be 400 tons of cotton seed for cattle food during the winter months, which would thus cause the condition of the sale cattle to be enormously improved and the prices obtained for them greatly enhanced.

497. *Progress of Cotton Work (Commercial). Ginneries.* (Extr. from the *Journ. Dpt. of Agr., S. Africa*, vol. x., **4,** 1925, p. 291.) Reporting on the progress of cotton work in his area, the Government Cotton Grader at Durban refers to the installation of ginneries by certain firms. One has installed two batteries of gins with delinters, also five occasional saw-gins and one roller-gin, with two delinters to each gin. These occasional gins are separate and complete units to deal with special seed cotton for seed purposes. In addition, there are three high-density presses, which conform to Government regulations. Another firm has two batteries of saw-gins with delinters and one high-density press. It is also installing a high-density compress, which will enable farmers who only have a low-density press to have their cotton repressed, and thus conform to the high density bale as demanded by regulation.

There are many new buyers concentrating in Durban, representing merchants from England and the Continent. A large number of merchants throughout the cotton world, including the United States, are appointing brokers at Durban to act on their behalf, and there appears to be every likelihood of a large competitive market there this year.

498. *Concerning Cotton.* By E. J. O'Connor. (*S. Afr. Cott. Growers' Journ.*, vol. i., **12,** 1925, p. 41, and subsequent number.) A discussion of prospects in South Africa.

499. *Sea Island Cotton.* By E. R. S. Chealos. (*Afr. Cott. Journ.*, vol. i., **9,** 1925, p. 28.) A discussion of the prospects of the cultivation of Sea Island cotton in South Africa; the writer seems on the whole against it.

500. TANGANYIKA TERRITORY. From the *Trade Report for* 1924 recently received, we learn that the figures for cotton show that the export was 66 per cent. greater in 1924 than in 1923.

501. *Cotton in British Togoland.* (Extr. from *Afr. Industries*, vol. i., **11,** 1925, p. 4.) It is satisfactory to report that a considerable impetus was given to the cotton industry by the high prices prevailing at the beginning of 1924, and which resulted in a great increase in the quantity exported. The farmers are taking more and more interest in cotton, and the crop is being carefully investigated by officers of the Agricultural Department.

502. UGANDA. (Abstr. from *East Afr.*, vol. i., **43,** 1925, p. 874.) In the discussion in the House of Lords upon the traffic congestion of the Uganda railways, the Secretary of State said that he had entire confidence in the General Manager's administration, and had every hope that, apart from largely artificial conditions prevailing during the last few months, the future handling of the Uganda cotton would give no reasonable ground for complaint. Trucks had been, and were being, poured into East Africa as fast as they could be assembled at Nairobi. Facilities on Lake Victoria were being increased by the provision of a new tug and lighters. New extensions of the railways leading into Uganda were expected to reach the borders by January next, and they anticipated no difficulty in handling Uganda traffic in future years, but if an abnormal amount of traffic was offered to the railway during any given period there might be temporary delay.

503. *Uganda Transport.* By W. F. Gowers, C.M.G., Governor of the Uganda Protectorate. (*East Africa*, vol. i., **43**, 1925, p. 867.)

504. From the report of the Mycologist, submitted at a meeting of the Plant Pests Board held in May last, we learn that an investigation into cotton diseases, in which valuable help was rendered by Mr. J. C. Hopkins, was carried out last December and January. The status of the various fungi found on Uganda cotton was cleared up as far as possible, and a memorandum summary of the present position was sent to all agricultural officers. One of the most important points in the investigation was that of determining the nature of a disease resembling black arm disease due to a bacterium (*Bacterium malvacearum* Efs.) This disease is now known to be present in the Sudan and Nigeria, and may be expected to show itself in Uganda. The actual material, however, did not show typical symptoms of black arm, and the casual bacterium was not isolated from it. It is hoped to continue the work on cotton diseases next season.

505. AUSTRALASIA: Fiji. *Cotton Cultivation. Instructions to Planters.* (Abstr. from *Agr. Circular*, Fiji, vol. 5, No. 2, 1925, p. 16.) Information is given to intending cotton planters under the following heads: Soils, preliminary cultivation, when to plant, spacing, after cultivation, picking, and guaranteed prices.

506. *Meade Cotton.* (*Agr. Circular*, Fiji, vol. v., **2**, 1925, p. 44.)

507. WEST INDIES. Cotton in Trinidad. By Dr. S. C. Harland. (*Proc. Agr. Soc. Trinidad and Tobago*, vol. xxv., **3**, 1925, p. 92.)

COTTON IN EGYPT.

508. EGYPT. Egyptian Cotton. Control. By G. Vaucher. (*L'Avenir Text.*, 1925, **7**, 4. Abstr. from *Summ. of Curr. Lit.*, vol. v., **13**, 1925, E. 70.) Steps are being taken, by the official control of cotton transport and markets in Egypt, to prevent the mixing of superior and inferior qualities of Egyptian cotton. Attention is also to be given to the selection of cotton seed and means for preventing the mixing of seed of different kinds. Direct contact has been established with many of the big manufacturing centres of Europe in order to ascertain exactly what types of cotton are most desired by the manufacturer.

COTTON IN THE UNITED STATES.

509. Culture of Pima and Upland Cotton in Arizona. By O. F. Cook and R. D. Martin. (*U.S. Dpt. Agr. Farmers' Bull.*, 1432 (1924). Abstr. in *Exp. Sta. Rec.*, vol. lii., 1925, p. 136.)

510. Field Crops Work at the Georgia Plain Coastal Station, 1922 and 1923. (*Georgia Coastal Plain Sta. Bulls.*, 3 (1923) and 4 (1924). Abstr. from *Exp. Sta. Rec.*, vol. lii., 1925, p. 225.) Varieties of cotton characterized by wilt resistance, earliness, sizable bolls, continuous fruiting throughout the season, and a good length and percentage of lint made the best in yields. Nitrogen applied in both organic and inorganic forms seemed to produce better yields of cotton than when derived from a single source. Maximum yields of cotton were made on an area poisoned with a home mixture of 1 gal. table syrup, 3 gals. of water, and 3 lbs. of calcium arsenate applied throughout the season with a hand mop, and at a low cost as compared with cotton poisoned with Hill's mixture and calcium arsenate dust. The Florida method was lowest in cost and apparently in effectiveness. The results suggest applying the home mixture first just before the squares appear and at seven or ten day intervals, depending on the weather, until the first blooms appear. Afterwards calcium arsenate dust should be used whenever required to control the weevil.

511. COTTON PRODUCTION IN VIRGINIA. By G. W. Patteson, Jnr. (*Va. Agr. Coll. Exp. Bull.*, 86, 1924. Abstr. from *Exp. Sta. Rec.*, vol. lii., 4, 1925, p. 336.) Available information on cotton production in Virginia is presented, with the results of variety tests, by E. T. Batten, at the Holland Substation. Trice, King, and Cleveland, with average acre yields of 1,175, 892, and 833 lbs. of seed cotton per acre, led the varieties in the order named, and their use is recommended.

512. COTTON PRODUCTION. By W. R. Perkins. (*La. Agr. Coll. Ext. Circ.* 70, 1924. Abstr. from *Exp. Sta. Rec.*, vol. lii., 4, 1925, p. 336.) Practical instructions for growing the crop in Louisiana.

513. FINANCE OF A COTTON FARM IN THE UNITED STATES. By M. R. Cooper. (Abstr. from the *Manch. Guard. Coml.*, April 16, 1925, p. 409.) An exhaustive examination of the cost of producing a pound of cotton in the United States. In 1923 the average net cost was 11d. per lb.; in 1924 it was slightly higher, but the increase was offset by a larger yield. For 1925 the prospects of a similar large yield are not so hopeful, and it is probable that there will be at least a moderate increase in the cost as compared with that of the previous year. To arrive at his figures the author has gone carefully into the question of the cost of man and mule labour, planting seed, fertilizers, ginning, insurance and taxes, use of machinery, use of land, and miscellaneous minor items of expenditure not previously classified. The sum of these costs is the gross cost of producing seed cotton, and the gross cost, less the value of the cotton seed, is considered the net cost of producing lint.

COTTON IN FOREIGN COUNTRIES.

514. We have received from the Association Cotonnière Coloniale *Bulletin No.* 70.

515. ROGUING OF COTTON. By J. B. Griffing. (*Nanking University Agr. and For. Series*, i., 2, 1920.)

I. *Report of Three Years' Cotton Improvement Work.* II. *Observations on the Behaviour of Cotton Plants, especially during Acclimatization.* By J. B. Griffing. (*Ibid.*, i., 6, 1923.)

These two papers, which have recently come into our hands, and are the latest published, should be taken together. Experiments have been undertaken since 1915 in cotton growing in China, particularly with regard to the introduction of American varieties; as a result of which successful production was obtained in the region around Nanking. In 1917 W. T. Swingle (Head of the Bureau of Crop Production in the U.S.) toured extensively through the cotton-growing tracts, and observed the universal mixture of types in the cotton fields. On his return he persuaded O. F. Cook (Head of the Cotton Department) to visit the country; and in the following year this officer took with him J. B. Griffing, who had been engaged on pure seed production of Pima cotton in Arizona for a number of years. A survey was made of the cotton tracts, and hundreds of fields were examined in eight provinces where American cotton had been introduced. Practically all of the fields contained mixtures, and the Upland plants showed the widest variations, most of them being of a very inferior character. Three principal cotton regions were separated: the valleys of the Yang tse-Kiang and the Hoang-Ho, and the coastal tract uniting and including these two rivers. In the last-named tract it was observed that the American cottons were unable to compete with the native varieties, because of climatic and economic conditions, so that the survey was extended to the latter, and certain areas were marked out as characterized by the growth of superior native kinds.

The results of this survey made a great impression on the cotton merchants and millowners, and two Associations offered conjointly to finance a three years' programme of cotton improvement work—namely, the Chinese Cotton Millowners Association and the Cotton Anti-adulteration Association of Shanghai. At their request Griffing undertook to carry out the work, laboratory accommodation being offered with the necessary land by the authorities of the Nanking University. Griffing first made a careful study of pure strains of Acala and Trice, which had been growing on the University farm for several years; and in the first paper mentioned above he gives the results of an analysis of a field of the latter variety which had been grown separately as a multiplication plot for three years. He found that the pure strain had broken down completely, and that the field contained a great number of forms. These varied from a few plants distinctly superior to the original Trice selection, through a moderate number which might be taken as fairly representative of it, to a large number which deviated or were distinctly inferior. Among the deviations were certain plants with good characters, but showing a marked "cluster" habit: these the author points out as interesting, in that one of the ancestors from which Trice was originally built up is said to exhibit this character. Five of these types are specially considered from the cropping and uniformity points of view, and are illustrated on photographic plates. These deviations were put down to lack of acclimatization; and the first line of work indicated from this study, therefore, was an attempt to find means rapidly to acclimatize and stabilize newly introduced pure strains of superior kinds of cotton. The second, considered of equal importance, was to explore the possibilities of obtaining and fixing pure strains of the better native kinds met with in the survey for growth on the large coastal belt.

The second bulletin, besides containing the historical details given above, gives a summary of the results of three years' work along these lines, and from its complexity can only be briefly referred to here. In his acclimatization work the author, taking the field of Trice again as a basis, while reintroducing it afresh, gives a series of diagrams and graphs illustrating the relative purity obtained year by year in his fields, treated as progeny rows and multiplication plots respectively. And he claims that within three years the work of acclimatization has so far been accomplished that large consignments of stabilized pure strain seed were ready for sending out to selected centres to form the nuclei of one variety cotton communities. He explains that this rapid progress was only rendered possible by working on a very large scale; and that he was helped by an army of carefully drilled students under trained teachers and professors gathered from the various universities dotted over the country, who threw themselves enthusiastically into the work without remuneration, while every assistance was given by the millowners and by other members of the Nanking University staff. Thus, 1,500 separate Upland plants were selected, labelled, and studied in detail; 630 progeny rows were grown, picked, and studied collectively and in detail; and 37 multiplication fields were separately picked, sampled, and ginned. Besides this, a large number of mission stations, in which agricultural work had been commenced, took up the cotton work under advice and control, and four of these, where cotton work had been previously carried on, organized special campaigns and laid down series of radiating experiment fields.

With regard to the second line of work, the selection and fixing of superior strains of native cottons, special attention was paid to the tracts noted in the survey as possessing superior native cottons in relative abundance. The author reports that hundreds of fields were examined (the greatest successes having been obtained through the energy of one Chinese professor); and over 1,000 individual plants were marked and studied. Of these, 300 were selected and grown in progeny rows; and altogether 40,000 selections from these were separately studied, and a further 1,500 progeny rows were grown from the best plants. As the result of this line of work, a number of native strains were selected and stabilized; and one outstanding form, little if at all inferior to Uplands, called "Million Dollar" by the students, surpassed every other. The difficult work of obtaining compact blocks, in the various selected tracts, of the improved varieties is being undertaken, but the success of this further work depends on many things, and in any case must take a considerable time. The methods employed in Arizona are being adopted, with deviations necessitated by the local conditions.—C. A. B. [Important on account of China's great potentialities.—Ed.]

COTTON: CULTIVATION AND MACHINERY.

516. The Improvement of the Cotton Seed Supply. By G. Evans, C.I.E. (Abstr. from *Queensland Agr. Journ.*, vol. xxiii., **3**, 1925, p. 183.) In the opening paragraphs of this article Mr. Evans describes the varying characters of the cotton seed that up to the present has been available for planting in Queensland, and urges the necessity for the substitution of this mixed seed by a pure variety suited to the country. The best advice was sought by departmental authorities, and in 1920 a small quantity of Durango seed was imported from the States, where experiments had proved that it yielded well under varying conditions, and was hardy. During the past four years this variety has been carefully tested all over Queensland and acclimatized in the country, and it is anticipated that next year there will be sufficient seed to plant more than the whole of the State, and the growers will be in a position to substitute their present unsatisfactory mixed seed by a pure long-stapled variety averaging $1\frac{3}{16}$ inches in length. Mr. Evans states, however, that this does not spell finality, as it is recognized by the Agricultural Department that it is possible that even better results may be obtained in some parts of the country with other varieties, and much time and attention therefore is being directed to the study of such promising varieties of cotton as Acala, Lone Star, Webber 49, Lightning Express, and Delta type Webber. It is hoped that as the result of all these experiments the Department of Agriculture will in a few years be in a position to offer to any particular community seed specially adapted to its local conditions.

517. The *Afr. Cott. Journ.*, vol. i., **8**, 1925, p. 5, gives hints to inexperienced growers on the way to select plants in the field for seed purposes.

518. Next Season's Crop, Southern Rhodesia. Advice on Soil Preparation. By C. D. (*Cott. News Wkly.*, vol. ii., **24**, 1925, p. 585.)

519. Manure With and Without Gypsum Treatment. (Abstr. *S. Afr. Cott. Growers' Journ.*, vol. i., 1925, 10, p. 22.) One ton of manure contains 500 lbs. of solids which are nearly all organic in nature. On standing, 250 to 350 lbs. of the total solids escape into the air as gases and water. Among the gases is ammonium carbonate, which contains about 7 lbs. of the valuable food nitrogen. All told, writes Professor G. A. Olson in *Farm and Ranch*, over one-half of the organic and one-half of the nitrogen matter are lost. The application of 40 to 80 lbs. of gypsum per ton of manure will reduce the loss of organic matter from 100 to 150 lbs., and of nitrogen from 2·8 lbs. to 3·5 lbs. As a result the soils are fortified with more organic matter (humus) and nitrogen than can be accomplished without treating the manure. Gypsum is also valuable as a plant food.

520. Cotton Plant: Manuring. By D. J. Burleson. (*Bot. Abstr.*, 1925, **14**, 601; from *Amer. Fertiliser*, 1924, **62**, 48. Abstr. from *Summ. of Curr. Lit.*, vol. v., **13**, 1925, E. 69.) Phosphoric acid stimulates early growth and fruiting of the cotton plant, and also hastens maturity. A large amount of available nitrogen makes the plant grow rapidly and gives it a dark green colour. The nitrogen should be mostly used up in the early part of the season so that the plant will not produce excessive vegetative growth. Potash makes the plant strong and rigid, and also tends to make it resist certain diseases such as rust.

521. IMPROVING THE FERTILITY OF THE SOIL. UTILIZING FARM MANURE TO BEST ADVANTAGE. (*Cott. News Wkly.*, vol. ii., **25**, 1925, p. 619.)

522. FERTILIZING THE COTTON CROP. By J. F. S. (Abstr. from the *Austr. Cott. Grower, Farmer, and Dairyman*, vol. i., **4**, 1925, p. 21.) For the benefit of new farmers in Australia who possess no particular information regarding the soil of their district, the author of this article suggests the following simple 3-plot test for estimating the fertilizer requirements of the soil:

No. 1 *Plot.*—To be left unmanured as a check.

No. 2 *Plot.*—To receive superphosphate at the rate of 1½ cwt. per acre at the time of seeding.

No. 3 *Plot.*—To receive superphosphate at the rate of 1½ cwt. per acre and nitrate of soda at the rate of ½ cwt. per acre, applied at the time of seeding, and an additional application of nitrate of soda at the rate of ½ cwt. per acre as a top-dressing at the time of thinning out the plants.

The plots should be uniform in all respects as regards soil and situation, etc., and should all receive identical treatment as regards planting and cultivation, and, in fact, everything except manuring. By observing the plots carefully and, if possible, by keeping accurate records of the yields from them separately, the comparative values of the different systems can be determined.

Such a test, if carefully conducted, should show what benefits are to be derived from the use of phosphatic, and also of nitrogenous, manures, and should be of the greatest value.

523. SOILS AND FERTILIZER EXPERIMENTS AT THE WELLCOME TROPICAL RESEARCH LABORATORIES, KHARTUM. By A. F. Joseph. (*Wellcome Trop. Res. Labs. Chem. Sect., Pub.* 30 [1923]. Abstr. in *Exp. Sta. Rec.*, vol. lii., 1925, p. 121.)

524. NITRIFICATION OF SOME SOUTH AFRICAN SOILS. PT. II. By T. D. Hall. (*Soil Sci.*, 18 [1924], No. 3. Abstr. in *Exp. Sta. Rec.*, vol. lii., **3**, 1925, p. 211.)

525. GROWTH OF THE COTTON PLANT: INDIA. By R. S. Inamdar, S. B. Singh, and T. F. Pando. (*Ann. Botany*, 1925, **39**. Abstr. from *Summ. of Curr. Lit.*, vol. v., **11**, 1925, A. 27.) Using the methods applied by Kidd, West, and Briggs to the analysis of growth in Helianthus, the authors have studied the relative growth-rates during successive periods of growth, and the relation between growth-rate and respiratory index throughout the life-cycle of the cotton plant in India. The growth-rate curves show a maximum increase; the shorter the vegetative period the earlier is the maximum reached. The maximum increase also supplies the necessary stimulus to the plant to set itself to produce reproductive organs, with an intervening latent period of about one month. The growth-rate curves are also compared with variations in the leaf-weight and leaf-area ratios, and the curve is divided into three phases: (1) An initial phase, when the growth-rate curve agrees with neither ratio; (2) an active phase, when the relative growth-rate curve runs parallel with the curve of either ratio; (3) the last phase of growth, when there is greater decrease in the growth-rate than can be accounted for by the decrease in the percentage leaf-weight or leaf-area ratio. The significance of these phases is discussed. A general discussion of the internal and external factors concerned in the dry-weight production by the plant is included. The course of the respiratory index runs parallel to the growth-rate curve.

526. COTTON PICKING MACHINE. (*Int. Rev. of Sci. and Pract. of Agr.*, p. 425. Abstr. from *Agr. Circ. of Fiji*, vol. v., **2,** 1925, p. 44.) A cotton picking machine worked on the suction principle has been tried out by a Toledo firm, the Banting Manufacturing Company. Each man controlling one of the aspiration tubes places the aspirator on the ripe cotton boll, which is immediately sucked in and conveyed to the cleaning chamber. The comb inside the suction tubes shuts out leaves and other foreign matter which would obstruct the passage or lower the grade of the cotton. The machine and the whole mechanism are mounted on a motor chassis handled by one man; 1 gallon of petrol is consumed per hour. The machine picks over eight rows at a time, and during the tests produced 2,300 kilos of fibre in ten hours of work, one mechanic and eight collectors being employed.

527. MECHANICAL COTTON PICKER. (Abstr. from *Text. Recorder*, vol. xliii., **508,** 1925, p. 97.) This machine, the invention of the late James P. Roach, of Mississippi, combines suction with a device consisting of several teeth, which, placed at the mouth of a long rubber hose, grip the cotton and pull it from the plant, then release it to the suction, which draws it down through the hose and ejects it at the other end into a receptacle. The gripping action of the teeth is said to eliminate the difficulty which developed from earlier inventions, and rendered them impracticable in that they twisted the cotton from the plant and broke the fibre. It is expected to try the machine out on the Texas cotton fields during the picking season.

528. FIELD PLOTS: MATHEMATICS. By R. Summerby. (*J. Amer. Soc. Agronomy*, 1925, 17. Abstr. from *J. of Text. Inst.*, vol. xvi., 1925, **5,** A. 150.) A study has been made of the influence of plat sizes, numbers of replications, and the frequency and methods of using check plats, in relation to accuracy in comparative crop tests. Under the conditions of experiment the results indicate that small plats are more accurate than large plats within the limits of the sizes and shapes used. There is a steady and rapid increase in accuracy as the number of repetitions is increased. The most rapid increase in accuracy is obtained as the number of repetitions is increased to four. With eight repetitions there is little difference in the degree of accuracy. It seems probable that the probable error cannot be reduced with certainty to less than 2 per cent. in comparative tests, even when as many as sixteen replications are made. Correction in no case was significant as measured by the standard of three times the probable error. In few cases was there uniformity in the several tests of each method. There was no consistency as regards the effect of more or less frequent checks, no matter what system of checking was used. Although no method was found efficient in reducing variability when measured in terms of probable errors, on the other hand, no errors were introduced. Moreover, plus corrections were much more frequent than negative corrections.

529. COTTON NEPS. By G. Butterworth. (*Text. World*, 1925, **67.** Abstr. from *Summ. of Curr. Lit.*, vol. v., **13,** 1925, A. 33.) Some photomicrographs of typical cotton neps are reproduced. The neps in a sample of lint cotton examined were found to be composed of masses of under-developed hairs, generally equal in length to the average, but thin, flat, and translucent, and in many instances still attached to the rudimentary seed coats or portions of them.

530. RAW COTTON: MIXING. (*Cotton*, 1925, **89,** 807. Abstr. from *Summ. of Curr. Lit.*, 1925, vol. v., **13,** F. 14.) In a discussion on the mixing of cottons of different staple lengths, it is brought out that the greatest difficulty is not in the length of the staple so much as in mixing cottons grown in different parts of the country. Thus, a Strict Middling Oklahoma cotton, which is wiry and curly, will not mix with a Strict Middling cotton grown in any other State, which is silky and soft. Lumpy work and weak yarn will be produced.

COTTON: DISEASES, PESTS, AND INJURIES.

531. A DISCUSSION ON THE GENERAL PRINCIPLES THAT SHOULD UNDERLIE GOVERNMENT ACTION RESPECTING FUNGICIDES AND INSECTICIDES. (*Ann. Appl. Biol.*, xii., 1925, p. 287.) At the meeting of the Association of Economic Biologists on November 14, 1924, this subject was introduced by Mr. J. C. F. Fryer. The full report is given, and should be read by all interested in legislation, as it is too long for a good abstract. The chief difficulty in the way of legislation is the existence of "secret" preparations, whose composition is not published, and may vary from time to time at the will of the manufacturer.

532. STUDIES ON CONTACT INSECTICIDES. III.: THE CHLOR-, NITRO-, AND HYDROXYL-DERIVATIVES OF BENZENE AND NAPHTHALENE. By F. Tattersfield, C. T. Eimingham, and H. M. Morris. (*Ann. Appl. Biol.*, xii., 1925, p. 218.) The toxicity to adults of *Aphis rumicis* L. and eggs of *Selenia tetralunaria* Hufn. was determined. Benzene was found less toxic to adults than toluene, this than xylene; and several other derivatives were yet more toxic. Phenol and the three isomeric cresols were found toxic only at high concentration, while other derivatives as before proved more active. The effect upon eggs was much the same.

533. ARSENICAL INSECTICIDES: PREPARATION. (*Ind.' Eng. Chem.*, 1925, 17. Abstr. from *Summ. of Curr. Lit.*, vol. v., **11**, 1925, E. 63.) The common arsenical sprays and dusts as now manufactured either have no electric charge or a negative charge when wet, and are therefore easily washed off the plants by the action of rain or dew. By forming basic arsenic compounds in the presence of a slight excess of a soluble metallic salt, the compounds have an adsorbed positive ion which gives them a positive charge when wet. Such positively charged particles are attracted and held to the negatively charged leaf surface, resisting the effect of rain and dews. A positive calcium arsenate has been made under commercial conditions and tested in the field, where the adherence was found to be from 196 to 259 per cent. greater than the standard calcium arsenate.

534. DUSTING *v.* WET SPRAYING: THE NUMEROUS ADVANTAGES OF DUSTS EXPLAINED. (*Cott. News Wkly.*, vol. ii., 1925, pp. 473-5.)

535. CONTROL OF INSECT PESTS AND MILDEW. By A. K. Johnson. (*Amer. Dyestuff Reporter*, 1925, **14.** Abstr. from *Summ. of Curr. Lit.*, vol. v., **11**, 1925, M. 29.) The author describes some experiences of the damage caused in the textile industries by insect pests and micro-organisms, such as wood-borers, cockroaches, moths, and carpet beetles, bacteria and mildew, and means for their control are outlined. In the discussion of the paper the following evidence was given: (1) Fluorides are most effective against cockroaches; (2) borax protected sized linen labels against cockroaches; (3) certain iron stains were traced to iron bacteria in bleachery water.

536. COTTON BOLL WORMS: THEIR LIFE HISTORY AND CONTROL. By D. S. Wilkinson. (Abstr. from *Cyprus Agr. Journ.*, vol. xx., **2**, 1925, p. 64.) An article written especially for the Cypriot cotton farmer, giving an account of the life-history of the Spiny Boll Worm (*Earias insulana*) and the Pink Boll Worm (*Gelechia gossypiella*), which have caused considerable damage this season to cotton in Cyprus, and suggesting methods of control.

The author states that for the control of Spiny Boll Worm legislation is now in force requiring the destruction of all cotton plants on or before a date fixed annually by the Director of Agriculture. The Government is also considering the question of legislation to enforce the heating of all seed for the control of Pink Boll Worm.

In view of the fact that the attack of these pests increases as the season advances, an early-producing variety of cotton is desirable, and the Department of Agriculture is experimenting with a large number of varieties to determine which is the most suitable for cultivation in the island.

537. The Survival of Pink Boll Worm Larvæ in Buried Seed during the Winter in Egypt. By C. B. Williams and I. E. Bishara. (*Tech. and Sci. Service Bull.*, No. 58. Obtainable from Government Publications Office, Ministry of Finance, Dawawin P.O., Cairo. Price P.T. 5.)

Summary.—The results obtained confirm entirely those reported by Willcocks, namely, that:

1. The death-rate of larvæ buried in the ground in winter is least near the surface and greatest at greater depths. At 30 centimetres there is no survival.
2. The moister the land is kept during the winter the more rapid the death-rate of the larvæ.

The larvæ die very rapidly in bersim, and few, if any, reach the following crop. In wheat they survive a little longer, and in dry fallow a number live till the next crop.

Excessive artificial watering, such as watering the land every two weeks, as in 1922–23, or a very heavy continual watering for a short period at the commencement, as in 1923 24, increases the death-rate to a still greater extent, and no moths reach the following crop under these conditions.

538. From the *Report of the Agr. Dept.*, 1924, recently received, we learn that Pink Boll Worm (*Pectinophora* [*Gelechia*] *gossypiella*) made its appearance in Grenada and Carriacou during the year. Legislation has been enacted for its control.

539. The Sudan Boll Worm a Serious Pest. By E. R. S. Cheales. *News Wkly.*, vol. ii., 1925, pp. 343 and 446-7.)

540. Jassid. (*S. Afr. Cott. Growers' Journ.*, vol. i., **10,** 1925, p. 52.) A preliminary report of experimental work carried out at Messrs. Kynochs, Ltd., Umbogintwini, with nicotine dusts, liquid contact sprays, and spraying with copper solutions, with a view to combating the damage to the cotton crop caused by jassid. Information is also given regarding the amount of spray required per acre, the machines necessary for spray application, and the possible cost of control measures.

541. A Jassid-Resistant Cotton. By Lloyd Worrall. (Abstr. from *Journ. of the Dpt. of Agr. S. Afr.*, vol. x., **6,** 1925, p. 487.) The continuation of an article in the above Journal in September, 1923. A jassid-resisting variety of Indian Cambodia cotton received from Coimbatore is doing well, and so far continues to prove resistant.

542. Eriophyes gossypii: A Mite Injurious to Cotton in Bahia, Brazil. By G. Bondar. (Uma nova doença do algodoeiro. *A Fazenda Moderna*, Year IX., Nos. 4-5, pp. 11-12. Rio de Janeiro, 1924. Abstr. in *Int. Rev. of the Sci. and Practice of Agr.*, Rome, vol. ii., No. 4, 1924, p. 1012.) Disinfection of the seeds with carbon disulphide before sowing is recommended.

543. Tsetse Fly and Nagane in Zululand. (*Journ. of Dpt. of Agr. S. Afr.*, vol. x., **5,** 1925, p. 417.)

544. Cotton Wilt: Burma. By D. Rhind. (*Rev. Appl. Mycology*, 1925, **4,** from *Rep. Mycologist*, Burma, June, 1924. Abstr. from *Summ. of Curr. Lit.*, vol. v., **11,** 1925, E. 64.) Wagale cotton on two farms was heavily attacked by a wilt disease due to a species of *Fusarium*, which destroyed 15 per cent. of the crop in one instance. The fungus is stated to be viable in the soil for at least three years, and a four-year rotation would probably reduce the incidence of the disease, for which no satisfactory means of prevention has been found. The Wagyi variety appears to be somewhat less susceptible.

545. COTTON WILT. (Abstr. from *Rev. of Agr. Operations in India*, 1923-24, p. 58.) Researches carried out in the Central Provinces on the wilt disease of cotton indicate that wilted plants contain a higher proportion of aluminium than healthy plants, and point to the toxic effect of aluminium as the primary cause of the disease, fungi being possibly secondary agents.

546. THE CAUSE OF COTTON BOLL SOFT ROT DISEASE.: WEST INDIES. By J. C. Hopkins. (*Ann. Bot.*, 1925, **39.** Abstr. from *Summ. of Curr. Lit.*, vol. iv., **11,** 1925, A. 26.) At least two species of *Phytophthora*, one of them apparently having two strains, are responsible for the soft rot disease of cotton bolls in the West Indies. Varying powers of virulence have been established for these fungi, and details of the relative susceptibility of resistance of six varieties of cotton described. It has been shown that St. Vincent, Montserrat, and Trinidad forms of *Phytophthora* excrete a cellulose dissolving enzyme which can cause a rot and cell separation in the absence of the fungus mycelium from the host tissue. The behaviour of zoospores, germination of the resting spore, and growth of the germ-tube are described, and details of the technique employed to illustrate their behaviour on the surface of the epidermis are furnished. Penetration of the boll and the passage of the fungus through the host tissues are followed, and the significance of certain structures is discussed. The rot resulting from growth of the fungus in the tissue and that due to enzyme are compared, and the similarity between the two pointed out. The possibility of control by spraying with Bordeaux mixture is indicated.

547. COTTON SORE-SHIN FUNGUS. By H. R. Briton-Jones. (*Rev. Appl. Mycology*, 1925, **4.** Abstr. from *Summ. of Curr. Lit.*, vol. v., **7,** 1925, A. 17.) The fungus *Rhizoctonia solani*, which is responsible for the "sore-shin" disease of cotton seedlings, was induced to produce its fertile stage, *Corticium vagum*, under experimental conditions. A marked variation in culture was observed between the strains from Egyptian cotton and some of those from other countries when grown under identical conditions. Strains from India, England, and U.S.A. were used, and the best medium for all was found to be steamed potato. The differences between some of these strains were retained throughout the experiments and affected the macroscopic characters of the cultures, rate of growth at different temperatures, and virulence on certain hosts. Differences in the microscopic characters were less clearly defined. The author regards all the isolations studied by him as strains of *R. solani*.

548. THE BACTERIAL DETERIORATION OF COTTON DURING DAMP STORAGE. By A. C. Burns. (*Journ. of Text. Inst.*, vol. xvi., **6,** 1925, T. 185.) The conclusions arrived at by the author are the following:

1. Bacterial and fungoid infection, as a source of serious deterioration of cotton during damp storage, is to be sought for and controlled in the unginned rather than in the ginned cotton.
2. Cotton which has been exposed to very damp storage prior to being ginned is much less resistant to bacterial or fungoid attack during subsequent normal storage than is cotton which has been stored under dry conditions prior to the ginning operation and from the time of picking the crop.
3. Ventilation of cotton during its storage "in seed" represses possible bacterial and fungoid deteriorative processes only in those cases where the damp material is able to "dry out" rapidly, otherwise such ventilation may lead to slightly increased deterioration of the cotton.
4. Sun drying of the cotton is advocated in addition to ventilation, particularly prior to storage in "seed," and prior to baling after ginning. The process of "damping" cotton before or during baling is not recommended.

549. COTTON: SPONTANEOUS IGNITION. By A. Dubosc. (*Chem. Zentr.*, 1925, **1.** Abstr. from *Journ. of Text. Inst.*, vol. xvi., **6**, 1925, A. 190.) The author discusses the composition of cotton and its spontaneous ignition by enzymes or bacteria (*cf.* abstr. 451, vol. ii., p. 272.)

550. SOME FEATURES OF THE BOLL WEEVIL PROBLEM IN THE UNITED STATES. By W. D. Hunter. (*Int. Cott. Bull.*, vol. iii., **12**, 1925, p. 652.)

And *cf.* also abstracts 504, 510.

COTTON: BOTANY.

551. COTTON: SELECTING. By O. F. Cook and R. D. Martin. (U.S. Dpt. of Agr. *Farmers' Bull.*, No. 1384, 1924. Abstr. from *Summ. of Curr. Lit.*, vol. v., **7**, 1925, E. 47.) In judging which variety is most suitable for a particular locality, the following considerations should be taken into account. Out-turn at the gin is not necessarily a true measure of yield per acre; and high out-turn, as in the case of "Half and Half," is usually associated with such inferiority of staple that it sells only at a large discount. Short staple varieties are not necessarily more productive than longer staples. Several very early and prolific varieties are known, which very often outyield short staple varieties. Among these are Acala, $1\frac{1}{8}$ to $1\frac{3}{16}$ inches; Lone Star, $1\frac{1}{16}$ to $1\frac{1}{8}$ inches; and Columbia and Durango, $1\frac{3}{16}$ to $1\frac{1}{4}$ inches. Some varieties are undesirable because they lack uniformity. Under boll-weevil conditions earliness and productiveness are important characters. There are, however, mistaken ideas of earliness, and in former years inferior, small-bolled varieties were grown on account of them. An early variety is rightly one that rapidly sets and matures a crop. This is not necessarily the same as the very early appearance of the first flowers or first open bolls. Some big-bolled varieties yield equally well. Very short-jointed or cluster varieties are more liable to excessive shedding and are difficult to pick. Long-jointed open-type kinds are late in maturing and poor yielders. Cultural operations are easier where plants stand erect, and spreading or prostrate varieties should be avoided. Varieties having a strong central stalk with short fruiting branches, and many of them, produce more flowers in a given time than varieties having long fruiting branches. The bolls on the former are set more rapidly, they are held from the ground and sustain less weather damage, and in consequence they are easier to pick. Staples longer than $1\frac{1}{8}$ to $1\frac{3}{16}$ inches are subject to extremely variable demand. In balancing the yield obtainable per acre for the different staples over at least five years should also be taken into consideration.

552. ENVIRONMENT AND QUALITY. By J. B. Hutchinson. (*Trop. Agriculture*, 1925, **2**, p. 134.) Discusses the effect of environment on the quality of the product of cotton and other crop plants. The quality may be radically changed with changed surroundings; the genetic constitution of the plant is unaltered, but its reaction with a different environment produces a very different result. As an example, the author states that St. Vincent Sea Island cotton grew excellently under irrigation conditions in the Sudan, but the lint hairs produced are said to have been "rod-like" and almost useless for spinning purposes. An account is given of the investigations carried out in Egypt by Dr. Balls on the effect of various environmental factors on lint length and hair strength.

553. FLOWERING, FRUIT-FORMATION, AND DEHISCENCE OF THE BOLLS OF THE COTTON PLANT. By G. S. Zaitsev. (Abstr. from *Agr. Journ. of India*, vol. xx., **3**, 1925, p. 209.) An account of some of the work carried out at the Turkestan Plant Breeding Station at Tashkent, from which we quote the following paragraph: "The vegetative period being in Turkestan comparatively short, it is of exceptional importance for a rich yield of the different sorts of cotton that they should ripen early. Early maturity is determined on one side by the time when the bolls begin to dehisce, on the other by the time when flowering begins. The advent of the latter phase settles the former, as between the period from sowing to flowering and the period from sowing to maturity (dehiscence of the bolls) there exists a direct, almost complete, correlation; thus the coefficient of the correlation (r), according to the data of the author, for the indicated relation has proved to be +0·875. Having determined for a number of forms of cotton plants the time of the beginning of their bloom and of the dehiscence of their bolls, it will be observed that the shorter is the time elapsed from sowing to flowering the shorter also is the time from flowering to the dehiscence of the boll; a protraction of the first period is followed by a protraction of the second also." The rest of the article is an interesting discussion with details, descriptions of way of flowering, boll shedding, crossing, and dehiscence.

554. ASIATIC-AMERICAN COTTON HYBRID. By G. S. Zaitzev. (*Agr. Journ. of India*, 1925, **20**. Abstr. from *Summ. of Curr. Lit.*, vol. v., **13**, 1925, A. 32.) The author has succeeded in crossing *Gossypium herbaceum* with *G. hirsutum.* The conditions of experiment were based on the following observations: (1) The alien pollen tube grows more slowly in the tissue of a strange flower than in its own, and the retardation is greater the more genetically remote the forms. (2) Under natural conditions the cotton flower is receptive to pollen during one day only. A complete exposure of the pistil by means of removing the whole corolla makes it receptive to pollination on the second day also. In the experiments described, therefore, the pistil was completely exposed by removing the whole corolla, together with the stamen tube. The hybrid obtained occupied an intermediate position between its parents in the majority of its characters, though several of the characters exhibited by the parents did not appear at all. An intensification of characters showed itself, and the male parent appeared to be dominant. The hybrid proved completely sterile. The author reports that his colleague Niklojeva has observed the chromosome number of Asiatic cottons to be 26, and that of American 52 (diploid numbers).

555. THICK-BOLLED COTTON: BREEDING. (*Scientific Amer.*, 1924, May, p. 348. Abstr. from *Journ. of Text. Inst.*, vol. xvi., **6**, 1925, A. 191.) It is stated that J. V. Cochran, of Marietta, Georgia, has bred out a cotton with bolls so thick that the boll weevil cannot penetrate to the lint. Spraying with poison is only necessary while the stalks are young.

556. DELFOS COTTON. (*Miss. Sta. Circ.*, 52 [1924]. Abstr. in *Exp. Sta. Rec.*, vol. lii., 1925, p. 136.)

CO-OPERATION.

557. THE CO-OPERATIVE MOVEMENT AS AFFECTING AGRICULTURE. (Abstr. from the *Rev. of Agr. Operations in India*, 1923-24, p. 79.) An account of the progress of the co-operative movement in the different provinces of India. During the year under report the value of cotton sold by co-operative cotton sale societies in the Bombay Presidency amounted to Rs. 53½ lakhs, as compared with Rs. 23.8 lakhs last year. The Hubli and Gadag Societies, which are the oldest, continued to extend their operations. The former dealt with about 5,000 bales of cotton, and carried on useful propaganda work with a view to encouraging the cleaner picking of cotton. The societies in Gujarat did business to the extent of Rs. 6½ lakhs. The distinctive features of the sale societies in Gujarat are that they sell only members' cotton, and that no one is admitted as a member who does not use the improved seed distributed by the societies.

558. AMERICA: THE SELLING OF COTTON BY CO-OPERATIVE METHODS. By C. F. Tainton. (Abstr. from *Afr. Cott. Journ.*, vol. i., **8**, 1925, p. 18.) The author states that "the success of co-operative selling of cotton and other crops seems to depend mainly on two things: (1) The method; (2) the officials. If the method is bad and permits members to escape from their agreements without penalty nothing can hold the Association. Again, if the officials are lazy or dishonest, failure is certain. To secure united and continuous action the contract system is necessary. Each member must sign a contract to abide by the rules, and must agree to pay penalties if he breaks his contract. The Association must be incorporated, and be able to enter into contracts and recover damages against those units who break the contract. Failure to enforce contracts when the majority has broken them is a common ending of a co-operative organization." An account is also included in the article of the successful working of the Staple Cotton Co-operative Association of the Mississippi Delta, which was formed for selling Delta cotton only, and does not handle any other variety.

559. THE AMERICAN COTTON GROWERS' EXCHANGE. By J. T. Orr. (Abstr. from the *Int. Cott. Bull.*, vol. iii., **12**, 1925, p. 647.) A very interesting account of the work of the Exchange, which has for its main objects the standardization of cotton varieties, the elimination of economic waste, the reduction of distribution costs, and the stabilization of prices.

CHEMISTRY AND PHYSICS.

560. A SORTING MACHINE FOR FLAX FIBRE-STRANDS AND SIMILAR MATERIAL. By J. A. Matthew and G. F. New. (*Journ. of Text. Inst.*, vol. xvi., **6**, 1925, T. 197.)

561. COTTON CULTIVATION: TEXAS. ("*Times*" *Texas Supplement*, March 31, 1925. Abstr. from *Summ. of Curr. Lit.*, vol. v., **8**, 1925, E. 55.) The competition for the largest crop grown on 5 acres of unirrigated land, which was promoted by a Dallas newspaper in 1924, was won by a grower at Palestine, Anderson County. From 5 acres 12,275 lbs. of seed cotton were picked, yielding 5,081 lbs. of lint, or over 2 bales per acre. This crop had no rain from May 29 to the middle of September. The land was broken between April 10 and 15, fertilizer was applied on May 5 at the rate of 400 lbs. of a 10-3-3 mixture, and a bushel to the acre of "Half and Half" was sown in rows 4 feet apart on May 7. On June 1 the cotton was chopped to a stand of one plant 12 to 16 inches in the row. The crop was cultivated ten times, and hoed twice through the growing season up to August 28; and a side dressing of 200 lbs. of a 12-2-3 fertilizer was applied on July 1. Cultivation occupied forty-nine hours per acre. The cost of production per acre was approximately 60 dollars, and the net profit 193 dollars per acre.

562. COTTON HAIR: MOISTURE ABSORPTION AND ELECTRIFICATION. By F. P. Slater. (*Journ. Text. Inst.*, 1925, **16**. Abstr. in *Summ. of Curr. Lit.*, vol. v., **8**, 1925, C. 37.)

563. THE CHLORIDE CONTENT OF THE LEAF TISSUE FLUIDS OF EGYPTIAN AND UPLAND COTTON. By J. A. Harris and J. V. and Z. W. Lawrence. (*Journ. Agr. Res.*, U.S., **28**, 1924, 7. Abstr. in *Exp. Sta. Rec.*, vol. lii., **4**, 1925, p. 327.) In a previous paper it was shown that some of the physicochemical properties of Pima Egyptian and Acala and Meade Upland cotton varied quite appreciably. In the present paper the authors present the results of a detailed comparison of the chloride content of the leaf tissue fluids of Egyptian and Upland cotton. It was found that almost without exception the chloride content was higher in the tissue fluids of the Egyptian than in the Upland cotton, and this is believed to indicate a greater capacity of the Egyptian type for growth on saline soils. (*Cf.* Abs. 135.)

564. COTTON PLANT STEAM DISTILLATE: CONSTITUENTS. By F. B. Power and V. K. Chesnut. (*Science*, 1925, **61**. Abstr. in *Summ. of Curr. Lit.*, vol. v., **11**, 1925, B. 47.)

565. Recent Developments in the Chemistry of the Cotton Fibre. By Dr. G. Tagliani. (*Journ. of Text. Inst.*, vol. xvi., **5**, 1925, P. 144.)

566. Cotton Pectin, Estimation of. By F. Hardy. (*Trop. Agric.*, 1924, **1.** Abstr. from *Journ. of Text. Inst.*, vol. xvi., **5**, 1925, A. 174.) A sample of Sea Island cotton was extracted with warm dilute hydrochloric acid in a vacuum apparatus, and the dissolved pectinogen precipitated as calcium pectate by the method of Haynes and Carré. The result indicated a pectin content of 1·2 per cent. The author suggests that it would be of interest to follow the changes in pectin content on storing, since this substance is so readily attacked by micro-organisms.

567. Cotton Cellulose: Action of Heat. By E. Knecht and E. F. Muller. (*Journ. Soc. Dyers and Col.*, 1925, **41.** Abstr. in *Journ. of Text. Inst.*, vol. xvi., **5**, 1925, A. 169.)

568. Cotton Cellulose: Action of Heat. By M. Fort. (*Journ. Soc. Dyers and Col.*, 1925, **41.** Abstr. in *Journ. of Text. Inst.*, vol. xvi., **5**, 1925, A. 169.)

569. Cotton Lea: Single Thread. Strength Correlation. By S. E. Smith. (*Text. World*, 1925, **67**, 1425. Abstr. in *Summ. of Curr. Lit.*, vol. v., **12**, 1925, L. 16.) The single strand test is considered to be more accurate and to give more nearly the actual strength of yarn than the lea test, and has the advantage of showing to what extent the yarns vary in strength, and, if carried sufficiently far, if the variations are occurring at regular intervals. There is no formula by which the single thread strength of any yarn can be converted to its corresponding lea strength. From the results of several thousand tests it appears that in the case of two-ply yarns made from Upland cotton the relation of the lea strength to the single strand strength averages about 114 : 1, the extreme ratios being 98 : 1 and 126 : 1. From similar tests on single yarns covering a wide range of twists and including both combed and carded yarns, the following figures have been derived: for hard twisted combed yarns, 98 : 1; for soft, 124 : 1; for hard twisted carded yarns, 99 : 1; for soft, 106 : 1.

570. Humidity in Cotton Mills. By H. Kershaw. (Abstr. from *Journ. of Text. Inst.*, vol. xvi., **5**, 1925, P. 163.) A lecture given before the Yorkshire Cotton Managers' and Overlookers' Society. The lecturer stated that in the mixing and blow rooms, for carding, drawing, and roving, a humidity of about 62 per cent. was to be recommended; for spinning about 50 per cent.; for winding, warping, and similar processes about 65 per cent.; and for weaving, 70 to 75 per cent.

571. Cotton Cleaning Machine. By F. and A. Wild, Ltd., and F. Quinn, Bolton, Lancs. Abstr. in *Journ. of Text. Inst.*, vol. xvi., **6**, 1925, A. 198.)

572. Cleaning of the Raw Cotton. By A. Manzoni. (Abstr. in *Journ. of Text. Inst.*, vol. xvi., **6**, 1925, A. 197.)

573. Raw Cotton: Oil-Spraying. By H. D. Martin. (*Text. World*, 1925, **67**, 2717. Abstr. from *Summ. of Curr. Lit.*, vol. v., **10**, 1925, F. 8.) Progress in the practice of oil-spraying raw cotton is traced. About thirteen mills employ this process. The oil used is a processed petroleum product known as Breton Minerol E. It is sprayed on the cotton either in the opening room bins, or preferably in the opener picker hoppers. Each picker is equipped with an atomizer connected with supplies of compressed air and oil, and about 1 lb. of oil is sprayed on 100 lbs. of cotton. Machinery running is facilitated, cards strip more easily, trouble due to static electricity is removed, and fly is reduced. There is evidence that the oil sprayed on the cotton penetrates the fibre and is retained. The quality of the goods is improved by oil-spraying, as fewer broken ends and, therefore, fewer knots and piecings are indicated.

574. RAW COTTON: OIL-SPRAYING. Textile Operating Executives of Georgia. (*Cotton*, 1925, **89**, 592-5. Abstr. from *Summ. of Curr. Lit.*, vol. v., **10**, 1925, F. 8.) In connection with the conditioning of cotton the method of oil-spraying is discussed. The consensus of opinion is that the method is entirely satisfactory whether white or coloured goods are manufactured. The amount of oil applied should not exceed 1 per cent. of the weight of the cotton. It eliminates static electricity and removes the need for humidification, whilst the amount of fly and dust is considerably reduced. An increase in breaking load of the yarn from oil-treated stock is claimed.

HISTORICAL.

575. HISTORY OF COTTON. By R. E. Massey. (Reprint from *Sudan Notes and Records*, 1923, **6**. Abstr. from *Journ. of Text. Inst.*, vol. xvi., **6**, 1925, A. 190.) A short note on the early history of cotton in Egypt and the Sudan. The earliest literary reference to the use of cotton for textiles, known to the author, is given by Herodotus, 450 B.C. The first good description of the plant is given by Theophrastus, and literary evidence is sufficient to show that cotton was well known in antiquity in India, the Persian Gulf, and Ethiopia.

MISCELLANEOUS.

576. In continuation of the article in the July number (p. 198), it should be pointed out that for those who desire more than the merest nodding acquaintance with the subject of Futures, an indispensable guide is provided in the little pamphlet by Mr. C. Stewart, *Cotton Futures: What They Are, and How They Work in Practice.* Published by the Author, 1, Cotton Exchange Buildings, Liverpool. Price 1s.

577. EMPIRE AND MISCELLANEOUS COTTON DELIVERY CONTRACT. (Abstr. from the *Int. Cott. Bull.*, vol. iii., **12**, 1925, p. 646.) The Liverpool Cotton Association adopted, at its meeting on July 7, 1925, the "Empire and miscellaneous cotton delivery contract," which is a new form of futures contract against which all growths of cotton not lower than the grade and value of strict low middling American cotton may be tendered, the contract only excepting certain grades of Egyptian cotton tenderable on the present Egyptian futures contract.

Thus, a hedge in the futures market is provided for growers and importers of Empire cotton, which it is hoped will greatly benefit Empire cotton growing. The formulation of this contract is the result of a long series of special committees and meetings of the directors of the Association, who have been giving very earnest consideration to this most important matter.

578. THE UTILIZATION IN INDUSTRY OF THE SHORT COTTON FIBRES ON THE COTTON SEED OF COMMERCE. By E. C. de Segundo. (Abstr. from *Int. Cott. Bull.*, vol. iii., **12**, 1925, p. 638.) An interesting article giving much useful information under the following heads: Cellulose value of residual cotton seed cotton; The cotton seed defibrating machine; Factory erected in England for defibrating cotton seed; Limitations of the saw-linting machine; Function of the cotton seed defibrating machine; Results obtained from seed-lint commercially produced; Market value of woolly cotton seed largely increased by defibration; Cotton seed a valuable raw material; Increasing use of cotton cellulose in the manufacture of artificial silk; New uses for cotton cellulose; Cleanliness a governing factor in the value of cotton seed cotton; Defibrated cotton seed for planting; Advantages of defibrating cotton seed before shipment; Financial aspect.

579. RESEARCH IN THE COTTON INDUSTRY. By Dr. J. C. Withers. (*Manch. Guard. Coml.*, July 2, 1925, p. 19.) A continuation of a previous article. (*Cf.* 225, p. 318, vol. i., 1924.)

580. WORLD PROBLEMS OF WOOL AND COTTON. By Professor A. J. Sargent. (*Journ. of Text. Inst.*, vol. xvi., **6**, 1925, P. 186.)

581. THE ECONOMIC SITUATION OF EUROPE AS IT AFFECTS THE COTTON TRADE OF LANCASHIRE. By Sir William Clare Lees. (*Journ. of Text. Inst.*, vol. xvi., **4**, 1925, p. 90.)

582. SCIENCE AND THE COTTON INDUSTRY. By A. J. Turner, M.A. (Published by the Indian Central Cotton Committee, Bombay.) A lecture delivered at the meeting of the Indian Science Congress held at Benares, January, 1925.

583. THE PRESENT POSITION OF COTTON RESEARCH IN INDIA. Indian Central Cotton Committee. (Published by the Government of India Press, Simla, 1925.) Opening with a statement of the policy of the Committee with regard to research, it is then pointed out that it has enabled forty-three more full-time scientific workers and ten research students to be employed on cotton problems, while the new Institute at Indore provides a central research station.

Work in progress is then described in detail. In long-staple regions the staple and yield are being improved by selection, while in short-staple regions the yield and the ginning percentage are being improved. Information is being collected, and experimental work is going on, bearing on the water requirements of the cotton plant, on bud, flower, and boll shedding, on pink boll worm, spotted boll worm, jassids, and other pests, and upon wilt disease.

Finally, summaries are included of the problems awaiting investigation, and of the future policy of the Committee. Everyone engaged in cotton research should procure a copy of this pamphlet.

584. THE PRICE OF COTTON FROM A WORLD STANDPOINT. (Abstr. from the *Int. Cott. Bull.*, vol. iii., **12**, 1925, p. 684.) Mr. Arthur Richmond Marsh, the Editor of *The Economic World*, has in his journal of June 6 a leading article on this matter. He shows that while the pre-war price of Middling Upland was about 12 cents. a pound in New York, and while American opinion still regards this as the real normal price, the world markets appear to be settling to a normal considerably higher.

585. A RÉSUMÉ OF INVESTIGATIONS OF COTTON SEED FLOUR AS HUMAN FOOD. By I. G. Macy and J. Outhouse. (*Journ. Home Econ.*, 16, 1924, **11**. Abstr. from *Exp. Sta. Rec.*, vol. lii., **4**, 1925, p. 364.) This is a brief review of the literature on the composition and nutritive value of cotton seed meal, and on cotton seed meal poisoning in animals. A list of twenty-five literature references is appended.

586. COTTON SEED VALUES AND USES. By E. R. S. Cheales. (*Cott. News Wkly.*, vol. ii., **23**, 1925, p. 561.)

587. COTTON CLEANING MACHINE. Haigh, Ltd., Oldham. (*Text. Mercury*, 1925, **72**. Abstr. *Journ. of Text. Inst.*, vol. xvi., **7**, 1925, A. 223.)

588. ARTIFICIAL SILK: A REVIEW OF BRITISH PROGRESS. THE INDUSTRIAL DEVELOPMENT OF VISCOSE. By A. B. Shearer. (*Journ. of Text. Inst.*, vol. xvi., **5**, 1925, P. 146.)

589. APPROXIMATE METHODS OF FARM SURVEYING. By T. A. Warner. (*Cott. News Wkly.*, vol. ii., **26**, 1925, p. 629.)

ERRATUM.

SPINNING TESTS: UGANDA COTTONS. On p. 249, *Remarks*, para. 2, last line but one, for "stronger by about **16** per cent." read "by about **24** per cent."

PERSONAL NOTES

APPOINTMENTS

SOUTH AFRICA.

Mr. F. S. Parsons has been appointed by the Corporation as an Agricultural Officer serving under Mr. Milligan in South Africa.

SOUTHERN RHODESIA.

Mr. J. E. Peat has been appointed by the Corporation as an Assistant to Mr. Cameron in Southern Rhodesia.

NORTHERN RHODESIA.

Mr. E. F. Salter has been appointed by the Corporation as Cotton Specialist in Northern Rhodesia.

NYASALAND.

Mr. W. L. Miller has been appointed by the Corporation as Farm Manager serving under Mr. Sampson in Nyasaland.

STUDENTSHIPS

The following have been elected to Studentships under the Corporation for the year 1925-26. They will hold their studentships at the place named in the second column:

SENIORS.

Name.	*Studentships Tenable at—*
E. R. Guest	Trinidad.
J. C. Haigh	Trinidad.
F. E. Kenchington	Trinidad.
J. V. Lochrie	Trinidad.
H. G. Miller	Trinidad.
S. R. de Villiers	Trinidad.
C. F. van Rooyen	Trinidad.

JUNIORS.

D. W. H. Baker	Rothamsted.
P. A. Bowmaker	Cambridge.
W. P. K. Findlay	Cambridge.
A. R. Keast	Rothamsted.
T. Lloyd Williams	Cambridge.
L. H. A. Stone	Cambridge.

The two last-named Senior Students were appointed by Mr. Milligan in conjunction with the Ministry of Agriculture, South Africa, from amongst candidates drawn from the Union. Two Junior Studentships are also to be awarded to men in South Africa selected jointly by the staff of the Corporation and by the Union Government, the Studentship year being spent in South Africa.

In addition to the above a special grant has been made to Mr. N. D. Clegg, a member of the Agricultural Department in Nyasaland, to assist him in taking a year's study leave at the North Carolina Agricultural College.

Of the men appointed by the Corporation last year as Supernumerary Officers attached to the Agricultural Department, Uganda, Messrs. Haig, Killick and Clay have already been absorbed into the regular establishment.

The holders of Senior Studentships last year have obtained appointments as follows:—F. S. Parsons has received an appointment under the Corporation in Natal, and J. E. Peat an appointment in Southern Rhodesia. J. W. Cowland has been appointed as an Assistant Entomologist under the Sudan Government, while C. H. Richards and H. Marsland have been appointed as Agricultural Inspectors under the same Government. J. V. R. Brown has been appointed as a Provincial Superintendent in the Agricultural Department, Sierra Leone; W. C. Lester-Smith has been appointed as Inspector of Plant Diseases, Ceylon. E. H. G. Smith has been offered a post as a Superintendent in the Agricultural Department, Nigeria. O. B. Lean is attached by the Corporation temporarily to the Agricultural Department, Nigeria, for entomological work.

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street) immediately opposite to the offices of the Crown Agents for the Colonies.

At the date of writing the following officers are on leave in England from cotton-growing countries:

Gold Coast	Mr. C. H. Knowles.
Kenya	Mr. P. Booth.
Nigeria	Mr. A. G. Beattie.
„	Mr. P. H. Lamb.
„	Mr. J. R. Mackie.
„	Mr. T. G. Mason.
„	Mr. A. W. J. Pomeroy.
„	Mr. K. T. Rae.
„	Mr. C. H. Wright.
Palestine	Mr. A. F. Nathan.
Tanganyika	Mr. R. W. R. Miller.
„	Mr. A. Pitcairn.
„	Mr. H. Wolfe.
Uganda	Capt. J. A. Harmsworth.
„	Mr. A. R. Morgan.
„	Mr. E. G. Staples.
„	Mr. R. T. Wickham.
Zanzibar	Mr. R. Armstrong.

Mr. S. Milligan, the Corporation's Cotton Expert in South Africa, is still on leave in this country.

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